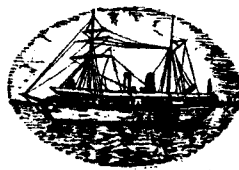
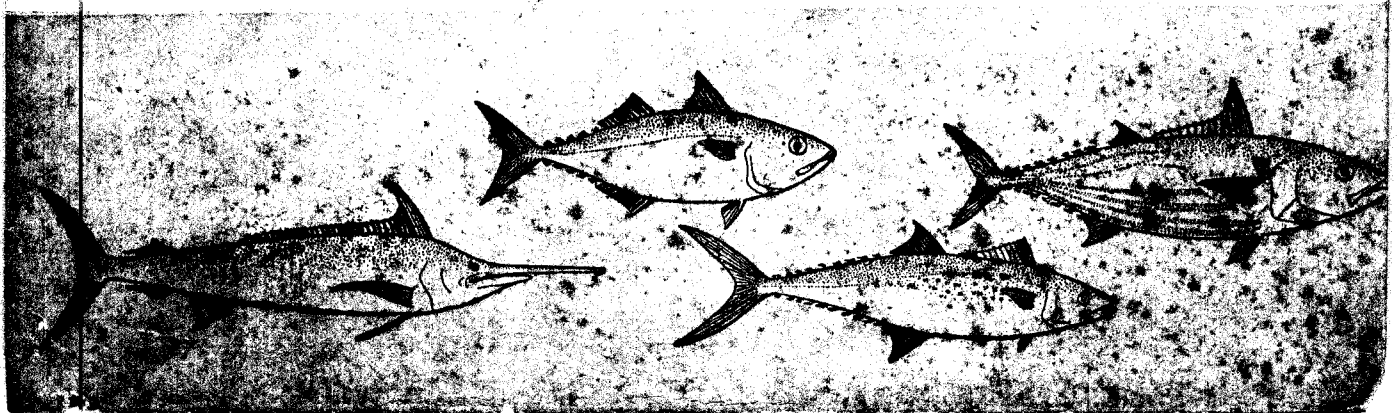


SYMPOSIUM ON SCOMBROID FISHES

PART III



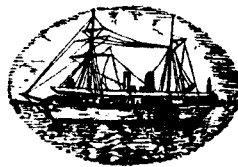
**MARINE BIOLOGICAL ASSOCIATION OF INDIA
MANDAPAM CAMP
S. INDIA**



PROCEEDINGS OF THE
SYMPOSIUM
ON
SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART III



SYMPOSIUM SERIES I
MARINE BIOLOGICAL ASSOCIATION OF INDIA
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PARASITES OF SCOMBROID FISHES. PART II. PARASITIC COPEPODA*

By E. G. SILAS and A. N. P. UMMERKUTTY

Central Marine Fisheries Research Institute, Mandapam Camp

INTRODUCTION

The literature on copepod parasites of fishes is profuse and ever increasing, and notable contributions which include parasitic copepods found on scombroid fishes are mainly to be found in the works of Brian (1906, 1935), Heller (1865), Kirtisinghe (1933-), Leigh-Sharpe (1930), Pearse (1951, 1952), Scott and Scott (1913), Shiino (1952-), Steenstrup and Lutken (1861), Wilson (1905-1944), Yamaguti (1936, 1939), and several others. A perusal of the literature shows that hardly a dozen species of copepod parasites have been described as new or recorded as occurring on scombroid fishes (mackerels, seerfishes or spanish mackerel, tunas and billfishes) found in the Indian seas, while at least 58 species appear to have been described or recorded (chiefly from eleven families of Caligoida and Lernaepodoida) from scombroid fishes from various parts of the world. Our collections from Indian scombroid fishes contain seven species of parasitic copepods, most of which are new distributional records.

Several of the points raised in the introductory part of Part-I of this series (Silas, 1962) are equally applicable in the case of parasitic copepods of scombroid fishes. Some of the parasitic species are known only from single scombroid species while a few are known to be more adaptable and infect fishes which belong to widely different groups, but perhaps occupying a similar habitat. No doubt, it is likely that future investigations may indicate the occurrence of certain parasitic copepods on scombroid fishes, which are at present known only from non-scombroid fishes.

In the absence of any detailed work on copepod parasites of scombroid fishes on a world wide basis, it is hoped that the data presented here will be of help to other workers interested in similar studies. While comments are offered by us for the different species, based on the material examined, as well as an evaluation of the data available in the literature consulted, this does not in any way constitute a critical review of parasitic copepoda of scombroid fishes. This should await more detailed investigations of this problem region-wise, which will eventually augment the list presented here and throw considerable light on the host specificity of these parasites as well as their spatial distributional patterns.

Brief descriptions of each species accompanied by illustrations, and data as to scombroid and non-scombroid host species, localities, locations of infection, etc. are given. A host-parasite list is also presented along with a detailed bibliography on copepod parasites of scombroid fishes. As in Part-I of the series, up-to-date names of scombroid host species are also given. Precise host identification is wanting in many instances, e.g. *Scomber scomber* from Lawson's Bay, Waltair, E. Coast of India (*Scomber scombrus* is known only from the Atlantic); 'swordfish *Xiphias zeugopteri*' (also from the above locality: we are unable to find any reference to this 'species' in ichthyological literature), etc., are mentioned from this area itself, which are incorrect and misleading. Since there is no recent monographic review of all groups of scombroid fishes on a global basis, the list of ichthyological references appended to Part-I of this series may be consulted for host identification.

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We will be thankful to readers for drawing our attention to species overlooked by us.

The material we have studied will be deposited in the Research Collection of the Central Marine Fisheries Research Institute, Mandapam Camp.

We are thankful to Prof. P. Kirtisinghe of Ceylon, and Prof. S. M. Shiino of Japan, for helping us with literature.

LIST OF PARASITIC COPEPODS OF SCOMBROID FISHES¹

SUB-CLASS : COPEPODA

ORDER : CALIGOIDA

FAMILY : CALIGIDAE

Genus CALIGUS Müller, 1785

- Caligus alalonga* Kroyer, 1863.
- Caligus bonito* Wilson, 1905.
- Caligus chelifer* Wilson, 1905.
- Caligus coryphaenae* Steenstrup and Lutken, 1861.
(Syn. *Caligus tesserifer* Shiino, 1952.)
- Caligus cybii* Bassett-Smith, 1898.
- Caligus germoi* Pearse, 1951.
- Caligus infestans* Heller, 1865.
- Caligus kuroshio* Shiino, 1959.
- Caligus macarovi* Gussev, 1951.
- Caligus mutabilis* Wilson, 1905.
- Caligus pelamydis* Kroyer, 1863.
- Caligus productus* Dana, 1854.
(Syn. *Caligus katuwo* Yamaguti, 1936 ; *C. monacanthi* Kroyer, 1863 ; *C. lobatus* Wilson, 1935.)
- Caligus quadratus* Shiino, 1954.
- Caligus rapax* Milne-Edwards, 1840.
- Caligus regalis* Leigh-Sharpe, 1930.
- Caligus thynni* Dana, 1852.
- Caligus* sp.

Genus ANURETES Heller, 1865

- Anuretes branchialis* Rangnekar, 1953.

Genus LEPEOPHTHEIRUS Nordmann, 1832

- Lepeophtheirus dissimulatus* Wilson, 1905.
- Lepeophtheirus eminens* Wilson, 1944.

¹ See 'Addendum' for additional list of species.

Genus PARAPETALUS Steenstrup and Lutken, 1861

? *Parapetalus* sp.

FAMILY : EURYPHORIDAE

Genus ALEBION Kroyer, 1863

Alebion glaber Wilson, 1907.

Alebion gracilis Wilson, 1907.

Genus ELYTROPHORA Gerstaecker, 1853

Elytrophora atlantica Wilson, 1932.

Elytrophora brachyptera Gerstaecker, 1853.

Elytrophora hemiptera Wilson, 1921.

Elytrophora indica Shiino, 1958.

Genus EURYPHORUS Nordmann, 1832 : Milne-Edwards, 1840

Euryphorus nympa Steenstrup and Lutken, 1861.

(Syn. *Euryphorus nordmanni* Kirtisinghe, 1937 ; *Euryphorus coryphaenae* Kroyer, 1863.)

Genus GLOIOPOTES Steenstrup and Lutken, 1861

Gloiopotes ornatus Wilson, 1907.

Gloiopotes costatus Wilson, 1919.

Gloiopotes hygomianus Steenstrup and Lutken, 1861.

Gloiopotes longicaudatus (Marukawa, 1925).

(Syn. *Gloiopotes zeugopteri* Rao, 1951.)

Gloiopotes watsoni Kirtisinghe, 1933.

FAMILY : CECROPIDAE

Genus CECROPS Leach, 1816

Cecrops latreillii Leach, 1816.

FAMILY : ANTHOSOMIDAE

Genus LERNANTHROPUS Blainville, 1822

Lernanthropus hiatus Pearse, 1951.

FAMILY : DICHELESTHIIDAE

Genus HATSCHEKIA Poche, 1902

Hatschekia mulli (van Beneden, 1851).

FAMILY : PSEUDOCYCNIDAE

Genus PSEUDOCYCNUS Heller, 1865

- Pseudocycnus appendiculatus* Heller, 1865.
(Syn. *Pseudocycnus thynnus* Brandes, 1955).
Pseudocycnus armatus (Bassett-Smith, 1898).
Pseudocycnus buccatus Wilson, 1922.
Pseudocycnus elongatus Pearse, 1951.
Pseudocycnus spinosus Pearse, 1952.

FAMILY : LERNAEIDAE

Genus LERNAEENICUS LeSueur, 1824

- Lernaeenicus longiventris* Wilson, 1917.
Lernaeenicus seeri Kirtisinghe, 1934.
Lernaeenicus sp. Rao, 1951.

FAMILY : PENNELLIDAE

Genus PENNELLA Oken, 1816

- Pennella biloba* Kirtisinghe, 1933.
Pennella costai Richiardi, 1880.
Pennella crassicornis Steenstrup and Lutken, 1861.
Pennella filosa (Linnaeus, 1758).
Pennella instructa Wilson, 1917.
Pennella orthagorisci Wright, 1870.

ORDER LERNAEOPODOIDA

FAMILY : CHONDRACANTHIDAE

Genus CHONDRACANTHUS Delaroche, 1811

- Chondracanthus lophii* Johnston, 1836.
Chondracanthus xiphae (Guerin) ? Cuvier 1829.

FAMILY : LERNAEPODIDAE

Genus CHAROPINUS Kroyer, 1863

- Charopinus quarternius* Wilson, 1935.

Genus BRACHIELLA Cuvier, 1817

- Brachiella ramosa* Richiardi, 1880.
Brachiella thynni Cuvier, 1817.
(Syn. *Thynnicola zeigleri* Miculicich, 1904).

Genus CLAVELLOPSIS Wilson, 1915

Clavellopsis saba Yamaguti, 1939.

Genus CLAVELLISA Wilson 1915

Clavellisa scombri (Kurz, 1877).

FAMILY : ANTHEACHERIDAE

Genus PHILICHTHYS Steenstrup, 1862

Philichthys xiphae Steenstrup, 1862.

SYSTEMATIC ACCOUNT OF COPEPOD PARASITES OF SCOMBROID FISHES

Order : CALIGOIDA

FAMILY : CALIGIDAE

Genus *Caligus* Müller, 1785

Body distinctly segmented, depressed ; anterior three segments fused with head ; fourth segment narrow, without dorsal plates ; genital segment enlarged, simple, devoid of dorsal plates or processes ; abdomen one- to four-segmented ; frontal plates with lunules ; maxillae simple, spine-like ; furca and maxillary hooks present ; first and fourth legs uniramous, second and third biramous ; basipods of third legs broadly laminate and fused into transverse apron reaching nearly across carapace ; three terminal segments of fourth pair of legs loosely fused and armed with setae or spines which are neither flattened nor winged.

Hosts : Mainly fishes.

Remarks : While several species of *Caligus* have been recorded from Indian seas (Gnanamuthu, 1949, Kirtisinghe (1956), and Rangneker (1956, a, b), apparently no species has been recorded as occurring on scombroid fishes¹. Our collections indicate the occurrence of two species, *C. bonito* from the oriental bonito *Sarda orientalis*, and the second from the sailfish *Istiophorus gladius*, which it has not been possible to identify beyond the genus, and hence given here as *Caligus* sp.

Caligus alalongae Kroyer, 1863.

Scombroid host : *Thynnus alalonga* [= *Thunnus (Thunnus) alalonga* (Bonnaterre)].

Locality : Mediterranean and Atlantic ; ? Ceylon (Kirtisinghe, 1937).

Non-scombroid hosts : None.

Location : Gills.

Remarks : Brian (1935) remarks that this species, originally described by Kroyer from males, and later commented on by Carus (1885) and Bassett-Smith (1899) is insufficiently known. Shiino (1959 f) remarks that Kirtisinghe's *alalongae* does not seem conspecific with Kroyer's. see 'Addendum'.

¹ See "Addendum" for several recent records.

Caligus bonito Wilson, 1905

(Figure 1: 1-10)

Material examined: Numerous specimens, adult females, males, and young stages (mostly chalimus and a few immature adults) were obtained from the buccal cavity (palate), and the gills and inner sides of operculum of the oriental bonito, *Sarda orientalis* (Temminck and Schlegel) taken in shore seines and drift nets off Vizhingam on the south west coast of India during September-October 1960.

Description: *Female*.—Carapace about one-third total length and slightly longer than wide; posterior median lobe of carapace broadly rounded and in level with posterior ends of bluntly rounded tips of lateral lobes which are slightly incurved; lunules large, conspicuous, and occupying a greater part of frontal plate; inter-lunular distance slightly more than lateral dimension of lunule; fourth segment short, very narrow, and constricted in front; genital segment elliptical, almost as large as carapace, lateral margins slightly divergent posteriorly ending in bluntly rounded projections; abdominal segmentation indistinct; abdomen long, rather spindle-shaped and 3.5 to 4.0 times as long as wide; a slight constriction towards posterior third of abdomen apparently indicates area of segmentation; anal laminae normally developed, each carrying five terminal plumose setae; egg strings elongate, broken and incomplete in all specimens.

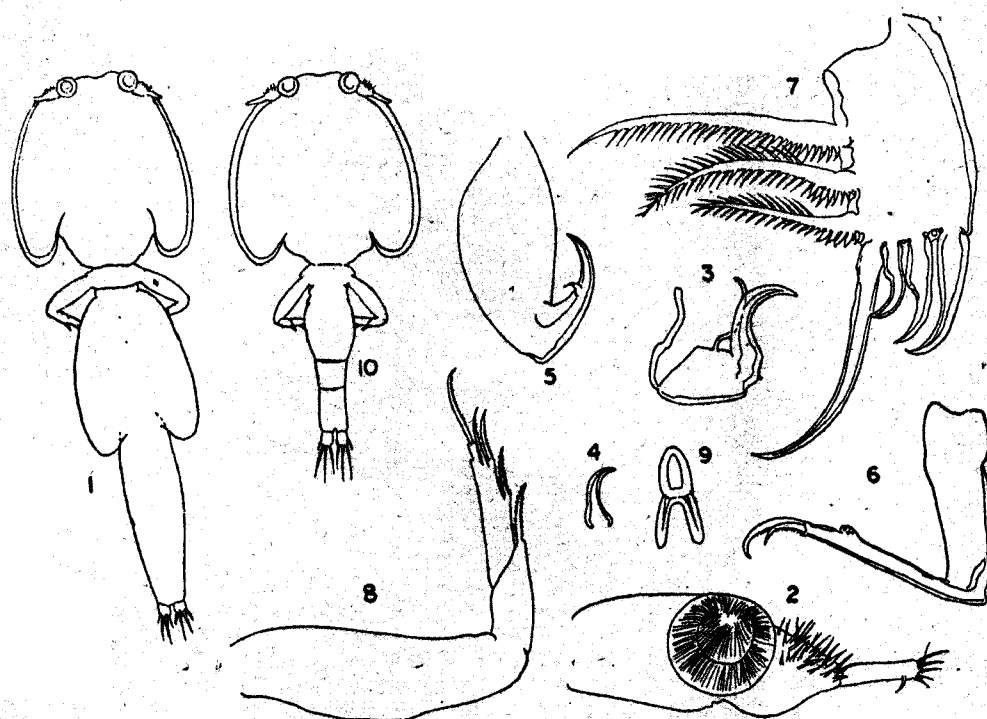


FIG. 1. *Caligus bonito* Wilson. *Female*. (1) dorsal view; (2) part of frontal plate lunule and antennule; (3) antenna; (4) maxillule; (5) second maxilliped; (6) first maxilliped; (7) terminal segment of first leg, enlarged; (8) fourth leg; (9) sternal furca. *Male*. (10) dorsal view (based on material collected from *Sarda orientalis* from India).

Male.—Carapace slightly longer than wide; fourth thoracic segment posteriorly much wider and consequently fourth legs attached to its posterior rather than to its lateral margins;

genital segment much longer than wide, its length about equal that of abdomen; abdomen two-jointed, segments of about equal length; antennules larger and longer than in female, especially basal joints with lunules; antennae not as stout as in female; maxillules about thrice as large; second maxillipeds with basal joint reinforced at distal end by a thick horny plate on its inner side.

- Scombroid hosts* :
1. *Gymnosarda pelamys* [= *Katsuwonus pelamis* (Linnaeus)]
 2. *Pelamys sarda* [= *Sarda sarda* (Bloch)]
 3. *Sarda chilensis* [= *Sarda chilensis chilensis* (Cuvier and Valenciennes)]
 4. *Sarda orientalis* (Temminck and Schlegel)
 5. *Scomberomorus cavalla* (Cuvier)
 6. *Scomberomorus maculatus* (Mitchell)
 7. *Cybium* sp. [= *Scomberomorus* sp.; ? *S. tritor* (Cuvier and Valenciennes)]
 8. *Sarda sarda* (Bloch)
 9. *Gymnosarda alleterato* [= *Euthynnus alleteratus* (Rafinesque)]

Localities : 1 and 2. Atlantic and Mediterranean; 3. Pacific coast of Mexico and Southern California (San Diego); 4. South west coast of India (Vizhingam); 5 & 6. Atlantic; 7. Mauritania Coast, W. Africa; 8. Texas Coast, U.S.A.; and 9. Grand Isle, Louisiana, U.S.A.

Non-Scombroid hosts : *Cratinus agassizii*, and *Lutjanus novemfasciatus* from Tangola, Mexico (Wilson, 1905); *Lutjanus* sp. from Mazatlan, Sinaloa, Mexico (Causey, 1960 obtained chalimus stages of *C. bonito* from this host); and Shiino (1960) gives *Lutjanus griens*, *Mugil cephalus*, *Oligoplites saurus*, and *Pomatomus saltatrix* as additional non-scombroid hosts.

Locations : Mouth, gills and insides of operculum. Wilson (1905) and Summer *et al.* (1913) remark that as many as 100 specimens of *C. bonito* may be collected from a single individual of *Sarda sarda*. In over 50 specimens of juvenile and adult specimens of *Sarda orientalis* examined by us, all had specimens of *C. bonito*, but not in such profusion. Generally about 2 to 10 specimens were found clinging to the roof of the mouth and bases of branchial arches. Very few were found on the gills and inside of operculum.

References : Wilson (1905); Brian (1924, 1935); Nunes-Ruivo (1956); Shiino (1959, 1960); and Causey (1953, 1960).

Remarks : Apparently *C. bonito* is a variable species, for descriptions and figures of the species from various localities indicate slight differences. An extreme case appears to be the material of *Caligus bonito* recorded by Yamaguti (1936) from Japanese waters which Shiino (1959) has redescribed from *Katsuwonus pelamis* (Linnaeus) and *Thynnus thynnus* (Linnaeus) as a new species *Caligus kuroshio*, which shall also be dealt with in this paper. Perhaps inadvertently Shiino (1960) has repeated Yamaguti's reference to *C. bonito* (= *C. kuroshio*) in the list of references under *C. bonito* Wilson.

Brian (1935) has drawn attention to some slight differences between his material from *Pelamys sarda* and that of the typical specimens described by Wilson (1905). In our material a few noticeable differences are seen in the nature and structure of the various appendages from that given by Wilson, and Brian. The shape of the genital segment is in agreement with that figured by Wilson (1905), but differs from the type for the Mediterranean specimens (Brian 1935) where the said segment is more or less of uniform width, while it is distinctly narrower anteriorly in our material. From Wilson's aforesaid description our material differs in the relative length of the terminal seta of the first pair of legs, it being hardly two times the length of the largest terminal spine in our material, while in the American specimens it is distinctly three times longer than the terminal spine. Brian's material agrees with ours in this respect, but shows two distinct constrictions in the abdomen which is not quite evident in our material.

A few salient characters of the species are: the furca with a bluntly conical basal part and moderately divergent branches, the latter not exceeding length of basal part; second maxilliped strongly built, terminal claw half as long as basal segment and with an accessory spine at about mid-length of its inner margin; denticulated nature of the basal part of lateral setae of first leg; fourth legs three-jointed, large, long, distal joint bearing three long curved spines at tip and a smaller one upon its posterior margin, and penultimate joint with a single stout spine at distal end of posterior margin (*Female*).

A detailed account of the material including a study of the different chalimus stages will be dealt with elsewhere.

Caligus chelifer Wilson, 1905

(Figure 2: 10-19)

Description: Female.—Carapace slightly longer than wide; lunules large, close together; fourth thoracic segment short, narrow; genital segment distinctly longer than broad, with anterior margin half as long as posterior; abdomen two-jointed, narrow, about four times as long

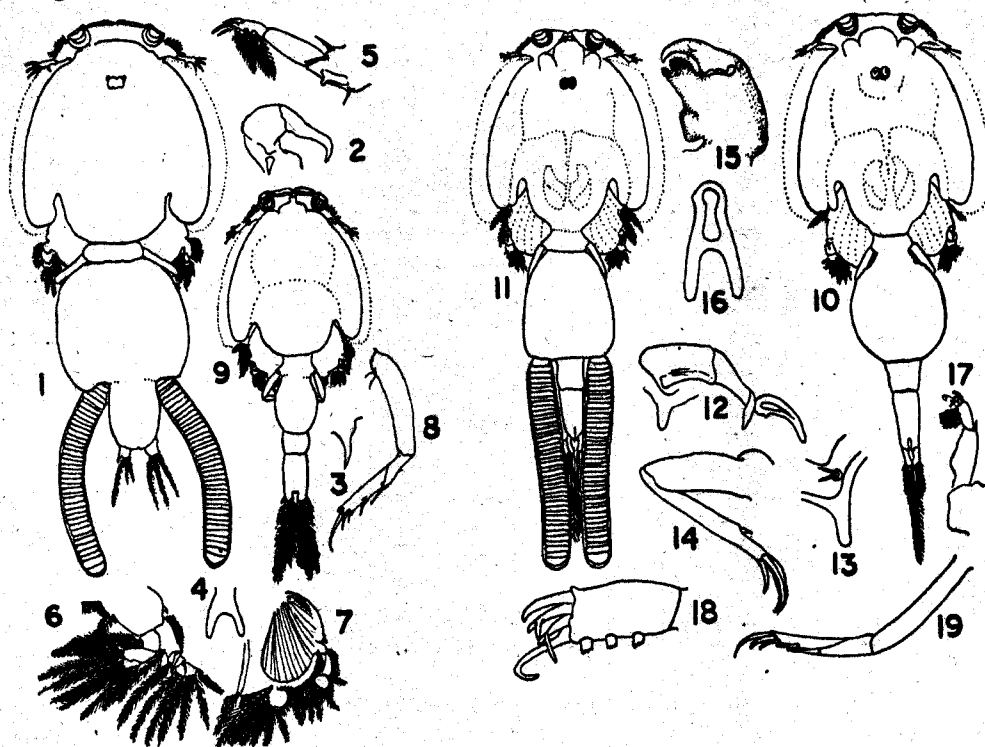


FIG. 2. *Caligus rapax* Milne Edwards. 1-8. *Female*. (1) dorsal view (2) antenna; (3) maxilla; (4) furca; (5), (6), (7), and (8) first, second, third, and fourth walking legs; *Male*. (9) dorsal view of adult male; *Caligus chelifer* Wilson 10-19. *Female*. (10) dorsal view of young female without eggs; (11) dorsal view of female with eggs; (12) antenna and maxillule; (13) maxilla showing rudimentary endopod; (14) first maxilliped; (15) terminal claw or chela of second maxilliped; (16) furca; (17) first leg; (18) terminal joint of same enlarged showing bifid spines, and (19) fourth leg (after Wilson).

as wide and second abdominal segment distinctly longer than first; anal laminae long, narrow, cylindrical in form and slightly converging at tips; egg strings broad, width as wide as abdomen

and each with 45 to 50 eggs ; among notable features of appendages, most of which are figured are : antennules small with two joints of same length ; slender antennae with slightly longer terminal claw than basal joint ; base of furca longer than branches, latter U-shaped ; unique prehensile structure of second maxilliped which has large and wide basal joint with two protuberances on its inner margin of which the basal one is large, hemispherical, with flattened tip ; distal, still larger, broad, digitiform, extending towards terminal claw forming an inarticulate half of a large chela (specific name derived from this structure) ; two middle terminal claws of first leg branched ; fourth leg three-segmented, with five spines and no setae.

Male : Unknown.

Scombroid host : *Xiphias gladius* Linnaeus.

Locality : Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic).

Non-scombroid hosts : *Brevoortia tyrannus*, and *Trichiurus lepturus* (Woods Hole, Mass., U.S.A.) ; taken free swimming in plankton haul on west coast of Africa (Brian, 1924).

Location : On external surface of body.

References : Wilson (1905, 1932) ; Brian (1924).

Remarks : The branching of the terminal claws of the first legs appears to be variable. According to Wilson (1905) : 'In the alcohol specimen taken from the menhaden, the two posteriors of the three terminal claws are branched, the branches being straight, longer than the tips of the claws and inserted nearly at right angles to the axis of the claw. In the living specimens obtained by the author from the sword-fish the claws are mostly unbranched, but are of the same relative size as in the menhaden specimen.' Wilson has also figured an adult female without egg strings in which the genital segment is almost spherical (Fig. 2 : 10), but with the characteristic features of the second maxilliped present.

Caligus coryphaenae Steenstrup and Lutken, 1861

(Figure 3 : 1-14)

(Syn. *Caligus bengoensis* Scott 1895 ; *C. aliuncus* Wilson, 1905 ; *C. tesserifer* Shiino, 1952 ; ? *C. scutatus* Milne-Edwards, 1840 ; ? *C. elongatus* Heegaard, 1943)

Description : *Female*.—Carapace longer than broad ; oval lunules at extreme lateral ends ; posterior borders of median lobe of carapace, and slightly incurved tips of lateral lobes reaching to more or less same level ; fourth thoracic segment constricted in front to form a 'neck' ; segment much broader than long ; genital segment flask-shaped with parallel sides which diverge slightly in posterior half and ends with slightly backwardly projecting triangular lobes on either side ; abdomen two-, three- or four-segmented, narrow and elongate ; egg strings thin and long ; mouth parts and appendages as shown in accompanying figures points of special interest being—distal joint of antennule shorter than basal joint ; branches of furca conical and diverging ; distal joint of first leg with four short terminal spines of which outer three are broad, flattened, with dentate margins, middle two with two short basal spines arising from their bulbous basal halves ; innermost spine, slender and simple, but slightly longer than two median spines ; inner margin of distal segment of first leg with three elongate setae, longest towards base of segment being three times longer than longest terminal spine ; fourth leg distally three-jointed carrying a total complement of five spines, three on terminal joint, one on penultimate joint and one on second joint.

Male.—Carapace longer than wide ; posterior border of median lobe of carapace projecting slightly beyond ends of lateral lobes ; fourth segment narrow considerably broader than

long, being as wide as genital segment; genital segment distinctly wider than long; abdomen relatively broad, more than half width of genital segment, two segmented, basal segment slightly

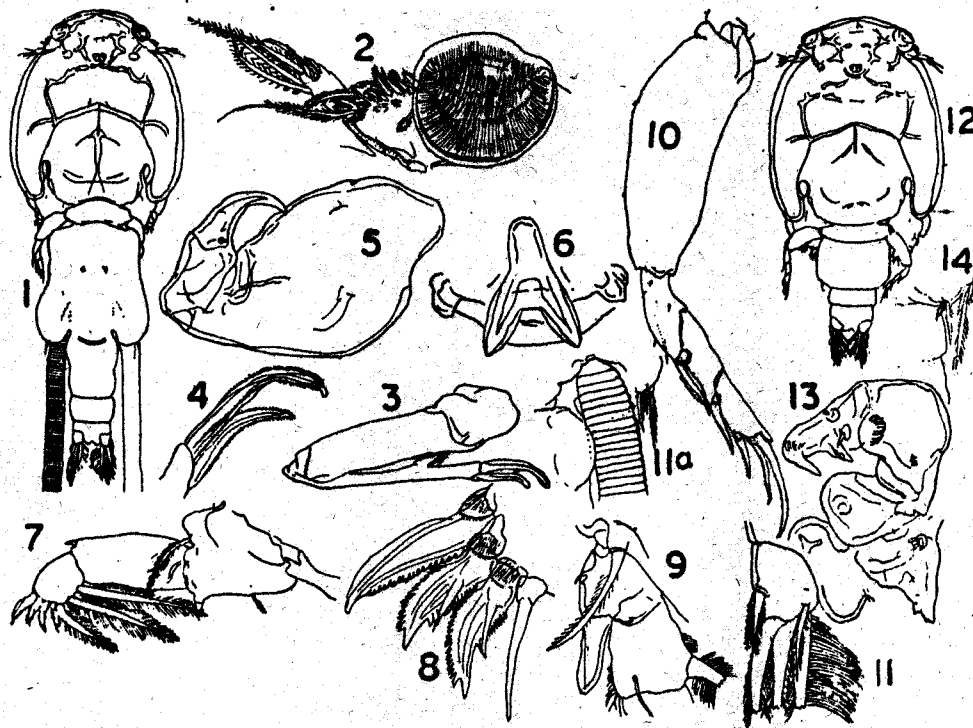


FIG. 3. *Caligus coryphaenae* Steenstrup and Lutken. Female. (1) dorsal view; (2) antennule; (3) first maxilliped; (4) same, terminal part; (5) second maxilliped; (6) furca; (7) first leg; (8) same, terminal part; (9) third endopod, posterior view of proximal part; (10) fourth leg; (11) anal lamina; (11a) posterolateral corner of genital segment. Male. (12) dorsal view; (13) antenna and maxilla; (14) posterolateral part of genital segment showing rudimentary legs (after Shiino).

shorter than distal which is lobed posteriorly; anal laminae as broad as long carrying distally three elongate and three short setae; terminal claw of antenna with a short sharp accessory spine at centre of inner margin and a short broad and blunt process at base; rudiments of fifth legs represented by round lobes tipped by a few setae at either posterior lateral angles of genital segment.

- Scombroid hosts*:
1. *Katsuwonus vagens* [= *Katsuwonus pelamis* (Linnaeus)]
 2. *Thunnus thynnus* [= *Thunnus* (Thunnus) *thynnus orientalis* (Temminck and Schlegel)]
 3. *Euthynnus yaito* [= *Euthynnus affinis yaito* Kishinouye]
 4. *Katsuwonus pelamis* (Linnaeus)
 5. *Euthynnus lineatus* [= *Euthynnus affinis lineatus* Kishinouye]
 6. *Katsuwonus* sp. [= *Katsuwonus pelamis* (Linnaeus)]
 7. *Neothunnus albacora* [= *Thunnus* (Neothunnus) *albacares macrop-terus* (Temminck and Schlegel)]
 8. *Sarda* sp.
 9. *Euthynnus alletteratus* (Rafinesque)

Localities : 1. Izu Peninsula, Japan ; 2. & 3. Hamajima, Mei Prefecture, Japan ; 4. Hamajima, Japan ; 5. St. Lucas and Guaymas, Pacific ; 6. Magdalena Bay, Gulf of California, Off Mexico ; 7. Indian Ocean (66° 31' E, 80° 00' S) ; 8. see Shiino (1959a) ; 9. Dry Tortugas, Atlantic.

Non-scombroid hosts : *Coryphaena hippurus* (Mediterranean ; Atlantic ; Gulf of California off Mexico ; Hamajima, Japan) ; *Coryphaena pelagica* (Mediterranean) ; *Isurus glaucus* (Owase, Mei Prefecture, Japan) ; ? *Polydactylus opercularis* (21° 26' N, 106° 06' W) ; *Squalus acanthias*, *Rachycentron canadus*, *Seriola dorsalis*, and *Caranx hippos* (See Shiino, 1959a ; Causey, 1953).

Location : On sides of body of host.

References : Steenstrup and Lutken (1861) ; Scott (1895) ; ? Milne-Edwards (1840) ; Richiardi (1880) ; Valle (1880) ; Carus (1884) ; Bassett-Smith (1899) ; Brian (1906, 1935) ; Wilson (1905, 1923, 1935, 1937, 1950) ; Heegaard (? 1943 ; 1949) ; Pearse (1952) ; Barnard (1955) ; Shiino (1952, 1959 a, b, c, and 1960).

Remarks : Shiino's (1959a) discussion on this species is quite comprehensive. He has shown that *Caligus coryphaenae* of Yamaguti (1936) is a synonym of *Caligus quadratus* Shiino (1954), while *C. tesserifer* Shiino (1952) is a synonym of *C. coryphaenae* Steenstrup and Lutken.

Caligus aliuncus was described by Wilson (1905) from a single female obtained free swimming from unknown locality taken during ALBATROSS collections. In 1935, Wilson recorded this species from *Euthynnus alletteratus* from the Dry Tortugas. The salient characters of *C. aliuncus*, namely, the four segments of the abdomen ; the winged margins of claws and spines of the distal segment of the first legs and the fourth legs respectively ; the accessory appendage at the distal end of the basal segment of the fourth leg ; etc. are also present for the earlier described *C. coryphaenae*. We would like to draw attention to certain variations seen in this species as noted from literature. Female specimen figured by Brian (1935 fig. 19, 2) has four abdominal segments, while three are shown by Shiino (1959a), and only two for *C. tesserifer* (Shiino, 1952). In the Japanese specimens the furca is broadly diverging and the fourth legs are distinctly three jointed (Shiino, 1952, 1959a), while in the Mediterranean specimens collected from *Coryphaena hippurus*, the branches of the furca are more or less parallel and slightly converge at tips giving the appearance of a narrow horse-shoe, and the segmentation in the distal half of the fourth legs is indistinct. See also remarks given in "Addendum".

***Caligus cybii* Bassett-Smith, 1898**

Scombroid host : *Cybium guttatum* [= *Scomberomorus guttatus guttatus* (Bloch and Schneider)]

Locality : India.

Non-scombroid hosts : None.

***Caligus germoi* Pearse, 1951**

(Figure 4)

Description : Female.—Carapace slightly wider than long ; genital segment barrel-shaped, one-fourth wider than long ; caudal laminae slightly broader than long, armed with three long plumose, one short terminal and one lateral plumose setae ; lunules feebly developed ; distal segment of antennule longer than basal, former terminating in six hooks and four setae ; antennae stout with two strong spines near base of hook ; maxillule with a spine on middle of median

margin; maxillae slender with two curved terminal setae; maxillipeds with two setae near base of second segment; terminal claw curved with two stout setae; furca with divergent branches slightly converging towards tips, basal part as long as branched portion and with a small spine-like protuberance at each angle and a stout conical median anterior spine; terminal segment of first leg with three spines and six setae; exopod of second leg with three segments, terminal segment lamellate bearing two spines and five setae; basal segment of third leg with a strong posterior hook; a sucker with five stout spines about its margin, a one-segmented setose exopod and a two-segmented endopod present towards median line from hook of basal segment; segmentation on fourth legs indistinct, with five terminal spines; fifth legs represented by two short spines at posterior end of genital segment.

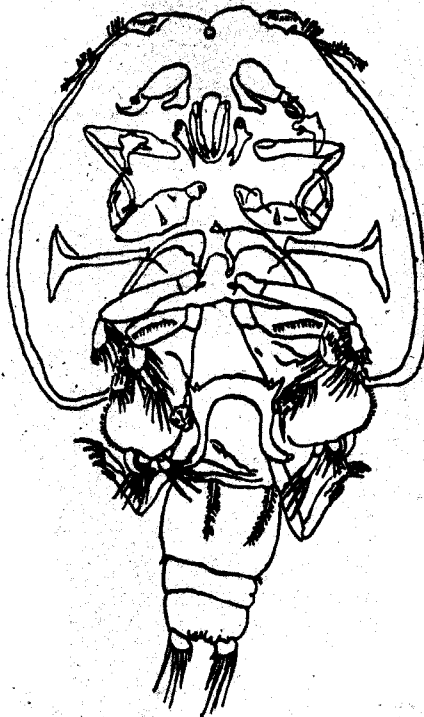


FIG. 4. *Caligus germoi* Pearse. Female, ventral view (after Pearse).

Male.—Unknown.

Scombroid host: *Germo alalunga* [= *Thunnus* (*Thunnus*) *alalunga* (Bonnaterre)]

Locality: Bimini, Bahamas, Atlantic.

Non-scombroid hosts: None.

Location: Gills.

Remarks: Pearse (1951) mentions his fig. 69d as 'ventral view of male' of *Caligus germoi*, (Fig. 4 reproduced here) which is an error as the male of this species is unknown. Additional characters noticed from the figure are: abdomen shorter than genital segment; first abdominal segment shorter than terminal segment; and width of abdomen almost same as genital segment. Pearse mentions that 'Between the bases of the third leg a furcula-like support bears a large and a small spine at each anterior lateral angle and two posterior arms that curve laterally and have acute tips'. It may be said that on the whole the species is not sufficiently known to institute

comparisons, but the following characters as mentioned by Pearse appear to be of specific importance : feebly developed lunules ; size and distribution of spines on antenna and maxillule ; character of furca ; characteristic furcula-like support between bases of third legs ; and a sucker armed with stout spines on each side of aforesaid structure on base of third leg.

***Caligus infestans* Heller, 1865**

(Figure 5 : 1-6)

Description : Female.—Carapace distinctly longer than broad, being half total length ; median lobe of carapace large, truncate, reaching far backwards of lateral lobes, latter slightly convergent ; fourth thoracic segment small, spindle-shaped ; genital segment large, distinctly longer, lateral margins slightly divergent posteriorly ending in broad lateral lobes, posterior margins of which are in level with hind end of first abdominal segment ; latter shorter than second ; anal laminae short, wider than long, bearing four plumose setae ; appendages as illustrated, noteworthy characters being : nature and disposition of lunule which are wide apart and not projecting ; ornamentation of first and fourth legs ; and shape of furca.

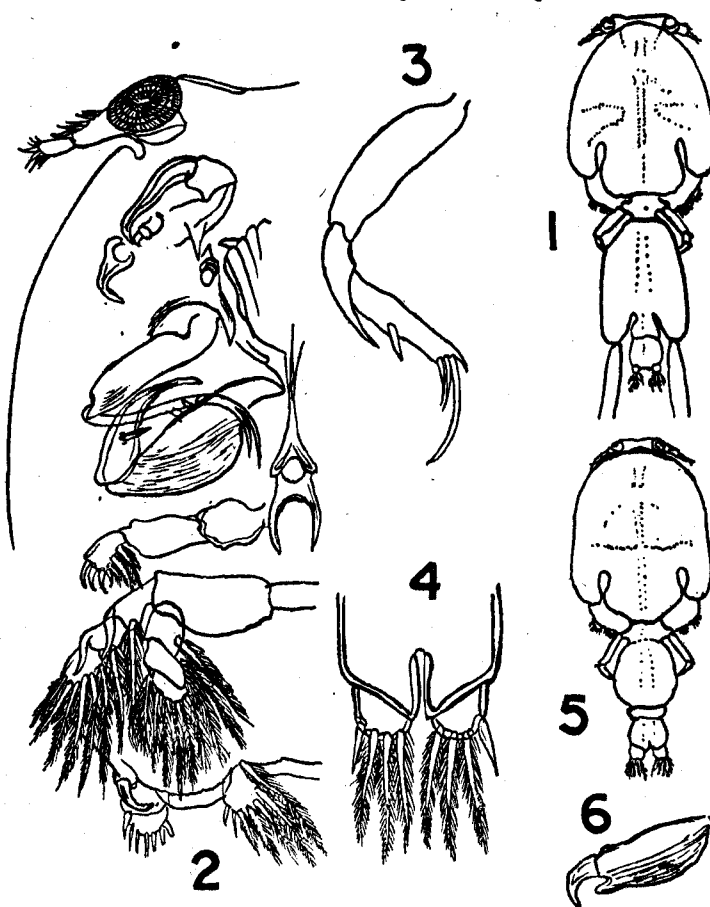


FIG. 5. *Caligus infestans* Heller. *Female.* (1) dorsal view ; (2) ventral view of one half of cephalothorax showing appendages ; (3) fourth leg ; (4) posterior end of body with anal laminae ; *Male.* (5) dorsal view ; (6) antenna (after Heller).

Male.—Carapace distinctly longer than wide and much more than half total length ; posterior extent of median lobe as in female ; genital segment ovate, hardly longer than broad, its length slightly more than length of abdomen and anal laminae ; first abdominal segment hardly one-third length of abdomen ; second segment broader along hind margin ; anal laminae as in female.

Scombroid host : *Scomber* sp. [= *Rastrelliger* sp. ? or ? *Scomber japonicus* sub. spp.]

Locality : Java, Indonesia.

Location : ?

Non-scombroid hosts : None.

Remarks : The host identification is not complete.

***Caligus kuroshio* Shiino, 1959**

(Figure 6 : 1-16)

(Syn. *Caligus bonito* Yamaguti, 1936, nec Wilson, 1905)

Description : Female.—Carapace slightly broader than long, length less than half total length ; posterior margin of median lobe in line with tips of lateral lobes ; fourth segment narrow, spindle-shaped ; genital segment longer than broad, posteriorly projecting into lateral lobes ; abdomen much shorter than genital segment being hardly two-thirds its length ; abdominal segmentation indistinct and abdomen narrower posteriorly ; caudal laminae longer than broad bearing six setae ; antennular segments of equal length ; terminal segment of first leg carries lateral setae of moderate length, longest equalling longest terminal spine ; as in *C. bonito*, terminal seta about two times as long as longest terminal spine ; base of lateral setae broad with denticulations along outer margin, rest of setae plumose. The illustrations given by Shiino (1959d) indicate general agreement of females of this species and those of *C. bonito* figured by Wilson (1905) and Brian (1935) for the other characters.

Male.—Carapace as broad as long ; extent of posterior median lobe as in female ; fourth thoracic segment narrow, spindle-shaped and slightly wider than genital segment ; latter anteriorly narrow and ringed, longer than abdomen and laminae ; rudiments of fifth and sixth legs seen ventrally ; basal segment of abdomen shorter than distal ; sexual distinction seen in maxillipeds and antennae.

Scombroid hosts : 1. *Katsuwonus pelamis* (Linnaeus)

2. *Thunnus thynnus* [= *Thunnus* (*Thunnus*) *thynnus orientalis* (Temminck and Schlegel)]

Localities : 1 & 2. Hamajima, Mie Prefecture, Japan (West Pacific).

Non-scombroid hosts : None.

Location : Gill cavity.

Remarks : The chief differences between this species and *C. bonito* appear to be in the relative lengths of the carapace, genital segment and abdomen, and the relative lengths of the setae and spines of the terminal segment of the first legs.

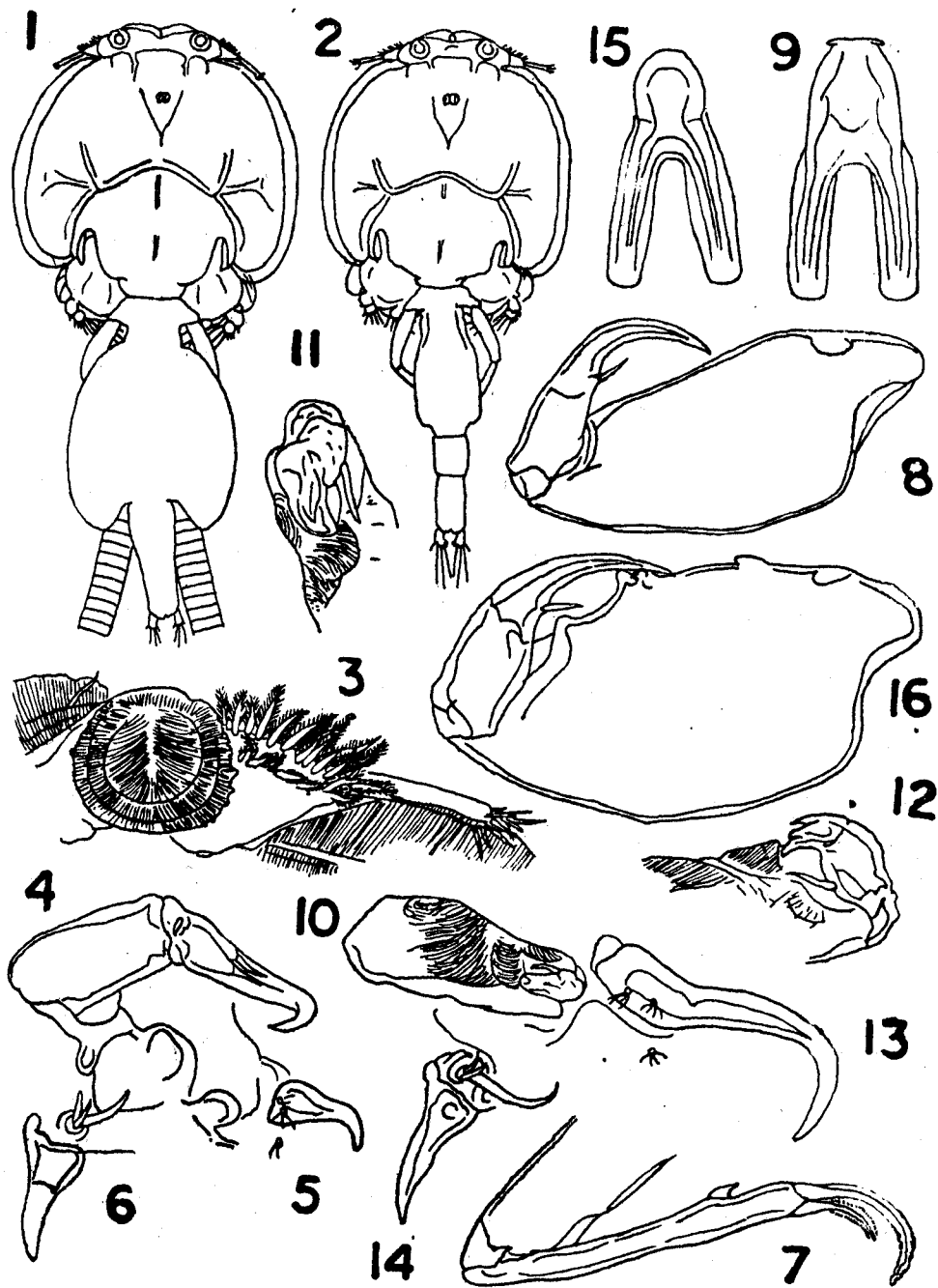


FIG. 6. *Caligus kuroshio* Shiino. (1) Female, dorsal view; (2) male, dorsal view; *Female*. (3) antennule; (4) antenna; (5) maxillule; (6) maxilla; (7) first maxilliped; (8) second maxilliped; (9) sternal furca; *Male*. (10, 11, and 12) different views of antenna; (13) maxillule; (14) maxilla; (15) sternal furca; (16) second maxilliped (after Shiino).

Caligus macarovi Gussev, 1951

(Figure 7: 1-14)

(Syn. *Caligus fulvipurpureus* Shiino, 1954, 1956)

Description: Female.—Carapace longer than wide; median lobe projecting beyond lateral lobes; fourth thoracic segment narrow, contracted in front and confluent with genital segment; latter conspicuously large, rectangular, almost as wide, but shorter than carapace; abdominal segmentation indistinct; abdomen about two-thirds as long as genital segment and as wide as fourth thoracic segment or half width of genital segment; caudal laminae longer than wide; antennule shorter than interlunular space, segments more or less of equal length; second maxilliped with a fusiform structure in basal segment to which the terminal claw reaches; furca with branches more or less parallel; three lateral setae on terminal segment of each first leg elongate

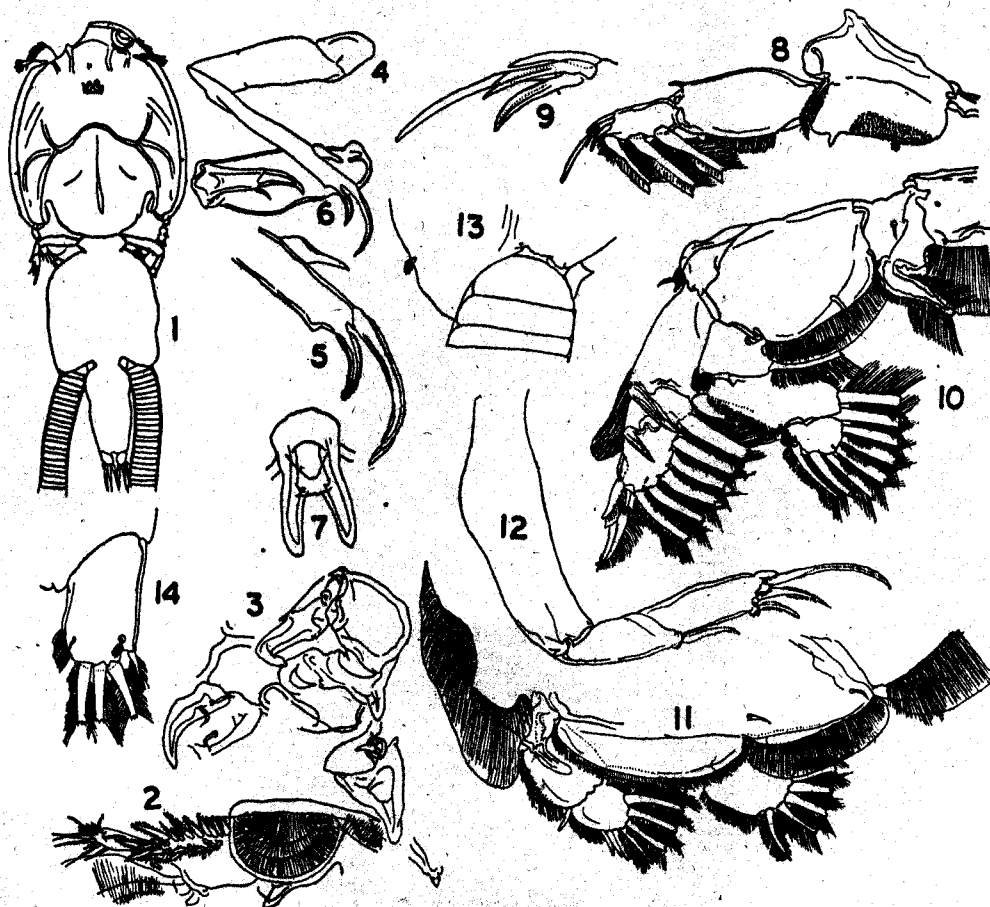


FIG. 7. *Caligus macarovi* Gussev. Female. (1) dorsal view; (2) antennule; (3) antenna, maxillules, and maxilla; (4) first maxilliped; (5) end of same; (6) second maxilliped; (7) sternal furca; (8) first leg; (9) tip of same; (10) second leg; (11) third leg; (12) fourth leg; (13) postero-lateral part of genital segment; and (14) anal lamina (after Shiino).

while three terminal spines and terminal setae short, latter atleast two times as long as longest terminal spine; inner two terminal spines bifid; fourth legs distally two-jointed with three

spines on apical and one on penultimate joints ; each spine associated at base with an oval pectinate lamina ; genital segment with a plumose spine on each posterior lobe on ventral side and a group of two shorter spinules internally which probably represent rudimentary legs ; egg strings about as long as total length.

Male.—Carapace broader anteriorly than in female, but agreeing otherwise with the latter ; fourth thoracic segment distinctly separated from genital segment ; latter one-third as long as carapace, three-fourths as wide as long and equal to length of abdomen ; laterally as well as at posterior angles of genital segment a pair each of rudimentary plumose appendages present, representing rudimentary fifth and sixth legs ; two-segmented abdomen, with basal segment half length of distal, but of equal width ; claw of antenna short, unguiform, penultimate joint elongate and columnar ; maxillule stouter than in female, sharp and falciform ; second maxilliped powerful, base inflated, half as broad as long and on inner margin with an eminent process against which the claw works ; branches of furca with apices more dilated than in female ; terminal spines on anal laminae much longer than in females.

Scombroid hosts : 1. *Euthynnus lineatus* [= *Euthynnus affinis lineatus* Kishinouye]
2. *Auxis maru* [= *Auxis thazard* (Lacépède)]

Locality : 1. Magdalena Bay, Gulf of California, off Mexico ; 2. Japan, Pacific.

Non-Scombroid hosts : *Spheroides rubripes*, *Cololabis saira*, and *Osmerus eperlanus dentex* (Japan and Northern Pacific).

Locations : Outside of operculum and ? between scales.

References : Gussev (1951) ; Markewitsch (1956) ; Shiino (1954, 1956 and 1959).

Remarks : Shiino (1954) has drawn attention to the affinities of his *C. fulvipurpureus* (= *C. macarovi*) to *C. cossackii* Bassett-Smith (1898), *C. rapax* Milne-Edwards (1840), and *C. polycanthi* Gnanamuthu (1949). Attention may be drawn here to the similarities found between this species and *C. chelifer* Wilson (1905), especially in the relatively large size of the genital segment, chelate nature of the maxillipeds, bifid nature of two terminal spines of distal segment of first leg, and in the nature of the anal laminae.

***Caligus mutabilis* Wilson, 1905**

(Figure 8 : 1-13)

Description : *Female*.—Carapace about as long as wide and about 2.5 in total length ; well defined frontal plates less than half width of carapace ; lunules large ; posterior median lobe of carapace extending slightly beyond level of tips of lateral lobes ; fourth thoracic segment short, narrow, hardly one-fourth width of carapace ; anteriorly slightly constricted, posteriorly truncate ; genital segment distinctly longer than broad, always constricted anteriorly into a short neck wrinkled across appearing as though segmented ; abdomen two-segmented, short, hardly two-thirds length of genital segment and about one-third its width ; basal segment slightly longer than terminal ; egg strings short, about half total length and each with about 50 eggs ; appendages as shown in accompanying figure but points of interest being : furca rounded Y-shaped, base being of same length as branches ; lateral setae of terminal segment of first pair of legs swollen at base and bordered with spine-like projections along outer margin in this area instead of usual plumose hairs ; fourth legs short, weak, three-jointed ; five spines of about same length situated close together along anterior margin.

Male.—Carapace slightly longer than wide and a little more than half total length; fourth segment much wider than genital segment; latter narrow, spindle shaped, considerably longer than wide, less than one-fourth width of carapace and as in female, wrinkled anteriorly; abdomen two-jointed, slightly shorter than genital segment, first segment unlike in female shorter than dis-

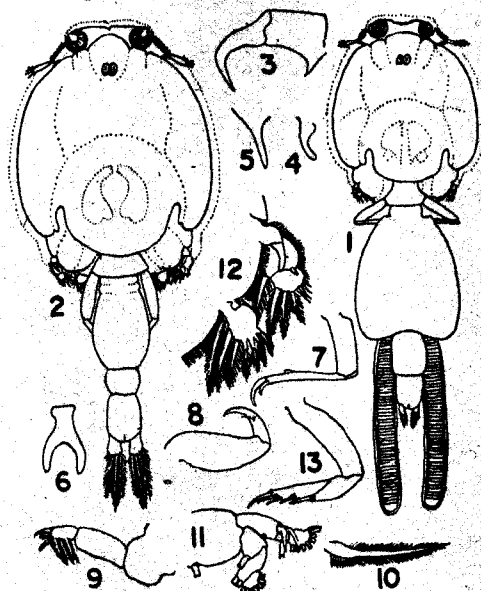


FIG. 8. *Caligus mutabilis* Wilson. (1) Female; (2) male; (3) antenna; (4) maxillule; (5) maxilla; (6) furca; (7) and (8) first and second maxillipeds; (9) first leg; (10) plumose seta from posterior border of terminal joint of first leg; (11), (12) and (13) second, third and fourth swimming legs (appendages from female) (after Wilson).

tal segment; antennae branched; maxillule elongated into long slender hook; maxillae large; fourth legs relatively large.

- Scombroid hosts* :
1. *Sarda sarda* (Bloch)
 2. *Euthynnus pelamys* [= *Katsuwonus pelamis* (Linnaeus)]
 3. *Sarda chilensis* [= *Sarda chilensis chilensis* (Cuvier and Valenciennes)]
 4. *Scomberomorus sierra* [= *Scomberomorus maculatus* (Mitchell)]

Localities : 1. Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic); 2. Guaymas, Sonora, Mexico; 3. Acapulco, Mexico (Pacific); 4. Cholla Bay, near Puerto Pensaco, Sonora, Mexico; Guaymas, Mexico; Mazatlan, Sinaloa, Mexico (Pacific).

Non-scombroid hosts : *Centropristis striatus*, *Pollachius virens* (Woods Hole, Massachusetts, U.S.A.); *Menticirrhus undulatus* (Ensenada, Mexico); *Calamus brachysomus*, *Paralabrax nebulifer*, *P. clathratus*, *P. maculatofasciatus* (Cholla Bay, Sonora, Mexico); *Selene oerstedii*, *Mugil cephalus* (Mazatlan, Sinaloa, Mexico); *Centropomus* sp., (San Blas, Nayarit, Mexico); *Balistes* sp. (Acapulco, Mexico); and *Chaetodipterus zonatus* (Salina Cruz, Oaxaca, Mexico) (Pacific).

Location : Buccal cavity of host.

References : Wilson (1905, 1932); Causey (1960).

Remarks : The sketch of the fourth leg of this species given by Wilson (1932, p. 406, fig. 253b) appears to be wrong.

Caligus pelamydis Kroyer, 1863

(Figure 9 : 1-11)

(Syn. *Caligus scomberi* Bassett-Smith, 1896)

Description : Female.—Carapace as long as broad, anteriorly narrower; about one-third total length; lunules minute and not projecting; abdomen two-jointed, longer than fourth and genital segments combined; basal segment five times as long as terminal; fourth thoracic segment narrow, spindle-shaped and separated from genital segment; fourth legs four-segmented with 5 spines and no seta; furca short with knobular base and broad and widely curving branches; appendages as shown in figure.

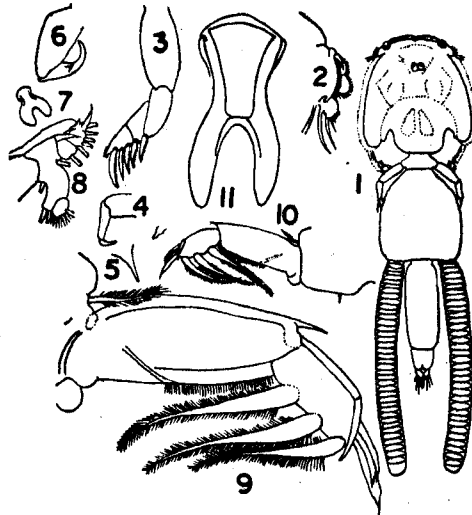


FIG. 9. *Caligus pelamydis* Kroyer. Female. (1) dorsal view; (2) third leg; (3) fourth leg; (4) antenna; (5) maxillule and maxilla; (6) second maxilliped; (7) sternal furca; (8) second leg; (9) first leg, distal part; (10) first leg; (11) sternal furca (figs. 1-8 after Wilson; 9-11 after Brian).

Male.—Carapace longer than wide, narrower anteriorly; fourth thoracic segment narrow, spindle-shaped, but broader than genital segment; latter, slightly longer than broad, but barrel-shaped; two-segmented abdomen slightly shorter than genital segment; basal segment shorter than terminal segment; anal laminae longer than broad and as long as first abdominal segment; fourth legs four-segmented (including basal segment) as in female.

- Scombroid hosts :**
1. *Pelamys sarda* [= *Sarda sarda* (Bloch)]
 2. *Scomber scombrus* Linnaeus
 3. *Gymnosarda pelamys* [= *Katsuwonus pelamis* (Linnaeus)]
 4. *Scomberomorus cavalla* (Cuvier)

Localities : 1 & 2. British waters, Irish Sea (N.E. Atlantic), and Mediterranean; 3. Woods Hole, Mass. U.S.A., (N.W. Atlantic); 4. Veracruz, Mexico (Gulf of Mexico); Texas Coast, U.S.A., Grand Isle, Louisiana, U.S.A.

Non-scombroid hosts : *Pogonias cromis* (Texas Coast, U.S.A.—Causey 1953).

Locations : Inside of operculum, gills and buccal cavity.

References : Kroyer (1863) ; Richiardi (1880) ; Valle (1882) ; Carus (1884) ; Bassett-Smith (1896-99) ; Brian (1899, 1935) ; Scott, T. (1901) ; Scott, A. (1906) ; Wilson (1905, 1932) ; Norman and Scott (1906) ; Stebbing (1910) ; Scott and Scott (1913) ; Brady (1910) ; Barnard (1955) ; and Causey (1953, 1960).

Remarks : Although reported from several localities from the Atlantic, and hitherto mainly from scombroid hosts, the species is relatively rare. Sumner *et al.* (1913) remark that *Caligus pelamydis* is usually found associated with *C. bonito*, a widely distributed species. Wilson (1905) has drawn attention to the discrepancies in Bassett-Smith's descriptions and figures of *C. scomberi* while relegating it to the synonymy of *C. pelamydis*. Wilson (1905, 1932) has shown the fourth thoracic segment to be confluent with the genital segment, while, Scott and Scott (1913) and Brian (1935) indicate these to be distinct. Scott and Scott (1913) draw attention to the rarity of the males of this species while describing it from a single specimen obtained after examining 1500 mackerel (*Scomber scombrus*). The host of this species from South African waters (Simons Bay) from where it was recorded by Brady (1910) and subsequently listed by Barnard (1955) is not known.

Caligus productus Dana, 1852

(Figure 10 : 1-17)

(Syn. *Caligus monacanthi* Kroyer, 1863 ; *C. monacanthi* (female) Wilson, 1937 ; *C. lobatus* Wilson, 1935 ; *C. katuwo* Yamaguti, 1936)

Description : *Female*.—Length of carapace equalling width ; posterior margin of median lobe in line with posterior tips of lateral lobes ; fourth thoracic segment very short, less than half width of genital segment and distinct from latter ; genital segment longer than broad, with very distinct lateral lobes which reach to posterior margin of first abdominal segment ; abdomen distinctly two-segmented, terminal segment about one-half times longer than basal, latter slightly narrower ; width of abdomen about three and a half times that of genital segment ; anal laminae longer than broad ; egg strings elongate, about three times length of abdomen ; antennules short with large lunules ; mouth parts as shown in figure ; first leg completely devoid of lateral setae on terminal segment, a feature most characteristic of the species and unique in the genus ; fourth leg three-segmented with five spines ; female with three rudimentary setae on ventral side of lateral lobes of genital segment indicating rudimentary appendages.

Male.—Carapace longer than broad, median lobe slightly extending beyond level of lateral lobes ; fourth thoracic segment spindle-shaped, larger than in female ; genital segment barrel-shaped, one half times wider than fourth segment ; abdomen two-segmented, slightly longer than genital segment ; first abdominal segment hardly half length of second ; caudal laminae longer than broad, equalling length of first abdominal segment ; sexual distinction noticeable in antennae and second maxillipeds ; clear rudiments of fifth and sixth legs seen on ventro-lateral part of anal segment.

- Scombroid hosts* :
1. *Gymnosarda pelamys* [= *Katsuwonus pelamis* (Linnaeus)]
 2. *Katsuwonus vagens* [= *Katsuwonus pelamis* (Linnaeus)]
 3. *Scomberomorus sierra* [= *Scomberomorus maculatus* (Mitchill)]
 4. 'Mackerel' [= ? *Scomber japonicus colias* Gmelin, or *Scomber* sp.]
 5. *Katsuwonus pelamis* (Linnaeus)
 6. *Thunnus thynnus* [= *Thunnus* (*Thunnus*) *thynnus orientalis* (Temminck and Schlegel)]
 7. *Neothunnus albacora* [= *Thunnus* (*Neothunnus*) *albacares macrop-terus* (Temminck and Schlegel)]

8. *Sarda sarda* (Bloch)
9. *Sarda* sp.
10. *Auxis thazard* (Lacépède)
11. *Scomberomorus cavalla* (Cuvier)

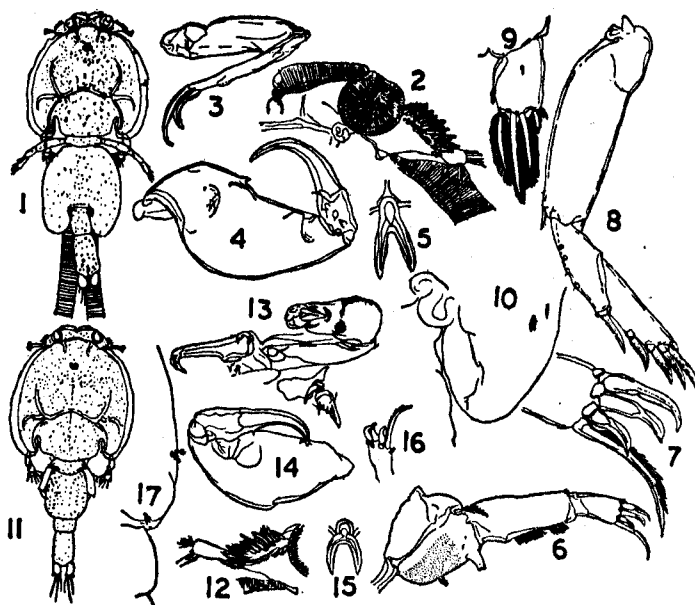


FIG. 10. *Caligus productus* Dana. Female. (1) dorsal view; (2) antennule; (3) first maxilliped; (4) second maxilliped; (5) furca; (6) first leg; (7) same terminal part; (8) fourth leg; (9) anal lamina; (10) Hind lobe of genital segment-ventral view; Male. (11) dorsal view; (12) antennule; (13) antenna, maxillule and maxilla; (14) second maxilliped; (15) furca; (16) terminal part of first leg; (17) ventral surface of genital segment showing rudimentary leg (after Shiino).

Localities : 1. Atlantic, Mediterranean; 2 & 3. Guaymas, Mexico and Texas Coast; 4. Cholla Bay, Sonora, Mexico; 5. Hamajima, Japan; 6. Same as 5; 7. Owase, Japan; 8 & 9. see Shiino (1959a); 10. 25° 31' N, 113° 18' W (Pacific; See Shiino, 1959a); and 11. see Shiino, 1959a and Causey 1953.

Non-scombroid hosts : *Coryphaena hippurus* (West Indies : Dana, 1854); *Balistes* sp., *Sphyraena* sp. (Steenstrup and Lutken, 1861); *Coryphaena* sp. (Kroyer, 1863); *Chrysophrys aurata* (Mediterranean); *Seriola dorsalis*, *Paralabrax clathratus*, *P. maculofasciatus*, *Verrunculus polylepis*, *Sphyraena argentea*, *Coryphaena* sp., *Lutjanus* sp., *Calamus brachysomus*, *Coryphaena hippurus*, and *Centropomus* sp. (Pacific coast of Mexico : Causey, 1960); *Polydactylus* (*Polyne-mus*) *opercularis* (21° 26' N, 106° 06' W: Pacific); *Sphyraena barracuda*, *Pogonias cromis*, *Mona-canthus* sp., and *Naucrates ductor* (See Shiino, 1959a).

Locations : Inner surface of gill covers and outer surface of body of host.

References : Dana (1852, 1854); Kroyer (1863); Steenstrup and Lutken (1861); Brian (1898, 1906, 1935); Bassett-Smith (1899); Wilson (1905, 1913, 1935, 1937); Rathbun (1884); Pearse (1952); Causey (1953a, b, 1955, 1960); Yamaguti (1936); Nunes-Ruivo (1956); and Shiino (1954, 1959a, b, c and 1960).

Remarks: Wilson (1905) has drawn attention to the differences in the descriptions of this species as given by Dana (1854), Steenstrup and Lutken (1861), Kroyer (1863) and as found in material examined by him. On account of the wide variety of host species involved, Causey (1960) remarks that there is little host specificity for *C. productus*, which has also been obtained by him from beach collections.

In view of the variability in this species we have followed Shiino (1959a) in recognising certain synonyms of *C. productus*. Shiino (1959e) has described three chalimus stages of *C. productus* from *Polydactylus (Polynemus) opercularis*.

***Caligus quadratus* Shiino, 1954**

(Figure 11 : 1-15)

(Syn. *Caligus productus* (female) Wilson, 1905 ; *C. monacanthi* (male) Wilson, 1937 ; *C. coryphaenae* Yamaguti, 1936 nec Steenstrup and Lutken, 1861)

Description: Female.—Carapace as long as or slightly longer than wide but distinctly less than half total length ; lunules small, orbicular, hardly projecting ; fourth segment very narrow, spindle-shaped, about one-fourth width of carapace and confluent with genital segment ; latter elliptical, longer than broad, with evenly curved sides and lateral incipient posterior lobes ; abdomen elongate, linear, slightly swollen at centre, segmentation indistinct and longer than genital segment ; egg strings hardly surpass caudal laminae ; each egg string with about 30 eggs ; appendages normal, except basal joint of second maxilliped which is stout and markedly swollen ; terminal claw small and hardly half length of former ; furca slender, knobular, with basal portion equal to length of stumpy divergent branches ; spines on exopod of second leg very long and acuminate ; terminal spines of distal segments of first legs flattened ; fourth leg short, three-jointed, with four or five spines.

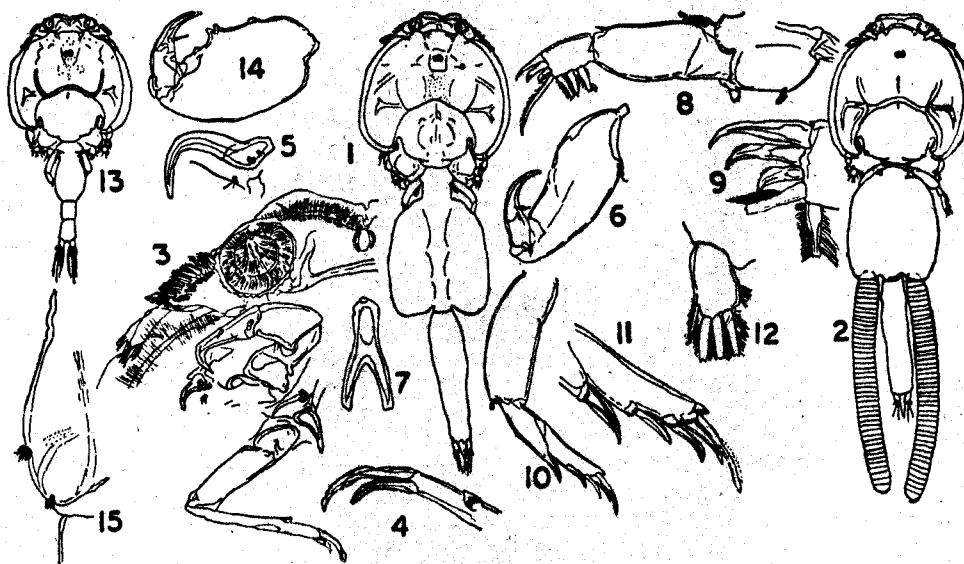


FIG. 11. *Caligus quadratus* Shiino. Female. (1) and (2) dorsal view, showing variability ; (3) cephalothoracic appendages, *in situ* ; (4) end of first maxilliped ; (5) maxillule ; (6) second maxilliped ; (7) sternal furca ; (8) first leg ; (9) same, terminal end ; (10) fourth leg ; (11) same, terminal part ; (12) anal lamina ; Male. (13) dorsal view ; (14) maxilliped ; (15) part of genital segment showing rudimentary legs (after Shiino).

Male.—Carapace as in female ; fourth thoracic segment relatively shorter and wider ; genital segment ovate, one-third longer than wide, with convex sides ; width much less than width of carapace, length equalling length of abdomen and anal laminae ; abdomen elongate, linear, with two distinct joints, basal segment slightly shorter than terminal ; appendages as in female, except antennae and second maxillipeds which are relatively larger ; rudiments of fifth and sixth pairs of legs present on ventro-lateral sides of genital segment.

Scombroid hosts : 1. *Neothunnus albacora* [= *Thunnus* (*Neothunnus*) *albacares macrop-terus* (Temminck and Schlegel)]
2. *Katsuwonus pelamis* (Linnaeus)
3. *Histiophorus orientalis* [= *Istiophorus gladius* (Broussonnet)]

Localities : 1. Shimakatsu, Japan ; 2. Hamajima, Japan, Pacific ; (?) Atlantic ; 3. Hamajima, Japan, Pacific.

Non-scombroid hosts : *Rhinobatus schlegeli* (Hamajima, Japan) ; *Coryphaena hippurus* and *Monacanthus* sp. (Atlantic) ; *Coryphaena hippurus* (Japan, Pacific).

References : Shiino (1954, 1959 a, b, and 1960) ; Wilson (1905, 1937) ; Yamaguti (1936).

Remarks : We are in agreement with Shiino (1959a) in his action of relegating the description and figures of a female '*Caligus productus*' given by Wilson (1905) to the synonymy of this species.

***Caligus rapax* Milne-Edwards, 1840**

(Figure 2 : 1-9)

(Syn. *Caligus elongatus* Nordmann, 1832, et Milne-Edwards, 1840 ; *Caligus leptochilus* Frey and Leuckart, 1847 ; *C. lumpy* Kroyer, 1863)

Description : **Female.**—Carapace longer than wide, median lobe projecting beyond level of posterior ends of lateral lobes ; fourth thoracic segment very short, about one-third width of carapace ; genital segment large, quadrangular, with rounded corners, slightly wider than long, about two-third width of carapace ; abdomen unsegmented, varying considerably in length from 0.5 to 0.8 length of genital segment and about half as wide as genital segment ; egg strings hardly longer than half total length ; mouth parts as figured.

Male.—Carapace as broad as long ; fourth thoracic segment considerably longer and narrower than in female ; genital segment pear-shaped, hardly one-third width of carapace and rounded laterally ; abdomen of two joints, same length as genital segment, first abdominal segment one half as long as second segment ; antennae and second maxillipeds stouter than in female and spine on side of latter much larger ; fourth legs with longer terminal joints.

Scombroid hosts : 1. *Xiphias gladius* Linnaeus
2. *Scomber scombrus* Linnaeus
3. *Scomberomorus maculatus* (Mitchell)
4. *Scomberomorus cavalla* (Cuvier)

Localities : 1 & 2. Atlantic, Mediterranean ; 3 & 4. Texas Coast, U.S.A.

Non-scombroid hosts : Mostly gadoids (British waters : Scott and Scott, 1913) ; *Mola mola*, *Syngnathus phlegon* (Mediterranean : Brian, 1935) ; *Acipenser sturio*, *Alosa sapidissima*, *Ammodytes americanus*, *Carangus crysos*, *Carcharias littoralis*, *Cyclopterus lumpus*, *Dasyatis centrura*,

Gadus callarias, *Kyphosus sectatrix*, *Melanogrammus aeglefinus*, *Menticirrhus saxatilis*, *Monacanthus hispidus*, *Paralichthys oblongus*, *Pollachius virens*, *Pomolobua pseudoharengus*, *Pseudopleuronectes americanus*, *Raja erinacea*, *R. laevis*, *R. ocellata*, *Remora remora*, *Roccus lineatus*, *Squalus acanthias*, *Stenotomus chrysops*, *Trichurus lepturus*, *Urophycis chuss*, *U. tenuis* (Woods Hole, Mass. U.S.A.); Gulf of Mexico in plankton (Wilson, 1950); *Hippoglossus hippoglossus*, *Limanda limanda*, *Paralichthys oblongus*, *Platichthys flesus*, *Pleuronectes platessa*, *Pleuronectes* sp., *Pseudopleuronectes americanus*, and *Scophthalmus rhombus* (Ronald, 1959); *Gadus morrhua*, *Trutta trutta* (Pesta, 1934); *Caranx hippos*, and *Prionotus* sp. (Causey, 1953).

Location : External surface of body.

References : Milne-Edwards (1840); Frey and Leuckart (1847); Baird (1850); White (1850); Steenstrup and Lutken (1861); Kroyer (1863); Olsson (1858); Macintosh (1874); Smith (1874); Bassett-Smith (1896, 1899); Scott, T. (1900); Brian (1908, 1912, 1935); Scott and Scott (1913); Wilson (1905, 1932, 1950); Timm (1894); Hofer (1904); Neresheimer (1909); Hanson (1923); Plehn (1924); and Pesta (1934).

Remarks : *Caligus rapax* is known from a variety of hosts and according to Wilson (1932) it is the most common species of the genus which apparently infests any fish host it comes across. Scott and Scott (1913) remark that it is not uncommon in planktonic collections and state that, 'Owing to the wandering habits of this *Caligus* there is scarcely a fish in our seas on which it may not at one time or other be found.' It is surprising that the species has not so far been recorded from the Indo-Pacific. For additional records see 'Addendum'.

C. rapax also evinces considerable variations in size; proportionate dimensions of various parts and also in colour. The last said is known to differ according to the colour of the host. Wilson (1905) has commented on the range of variations that may be expected in the fourth pair of legs of this species, especially in specimens from the mackerel which appears to show the maximum variations as, 'Sometimes the second of the terminal spines, counting from the proximal end of the terminal joint, is wanting. Again, the ultimate and penultimate joints are relatively shorter and stouter than in the normal specimens; or the three successive spines on the outer margin may overlap one another; or the fringed discs at the bases of these spines may be so little developed as to be overlooked.'

***Caligus regalis* Leigh-Sharpe, 1930**

(Figure 12 : 1-11)

Description : *Female*.—Carapace distinctly longer than broad; lunules large; fourth thoracic segment short, wider than long; genital segment oblong, much longer than wide, posterior lobes sharply arcuate, incurved nearly to touch abdomen; latter two-segmented, segmentation indistinct; first segment about thrice longer than second; anal laminae confluent with distal abdominal segment, broader than long and bearing four plumose setae each; antennule conspicuously long; lunules large and lateral diameter contained 1.75 in inter-lunular distance; antenna two-jointed, basal joint massive, provided with a heart-shaped thickening (chitinous) against which strongly recurved unciform terminal claw bites; basal segment with a small projection carrying two unequal spines; other cephalic appendages as figured; branched portion of furca horseshoe-shaped, slightly longer than basal portion; basal joint of first pair of legs much enlarged where it joins middle joint, terminal joint provided with three bifid terminal spines and a short terminal seta, and three inner long plumose setae; fourth pair of legs three segmented (including basal), terminal segment small, ending in a postero-lateral, one small and three large apical setae; fifth legs vestigial, represented by a pair of unjointed papillae bearing three setae on postero-ventral process of genital segment; young females with abdomen distinctly segmented; egg strings as long as body minus abdomen.

Male.—Differing from female in : shape of genital segment, abdomen, second antennae, fourth legs, presence of sixth pair of legs, and smaller size. Genital segment much wider than long ; abdomen two-segmented, distal segment twice that of basal in size and squarish ; distal joint of antennae bearing a second lateral hook ; furcal branches not converging ; structure of fourth legs (segments of different length, terminal joint slightly longer instead of being shortest as in female) ; and sixth pair of legs which bear two setae.

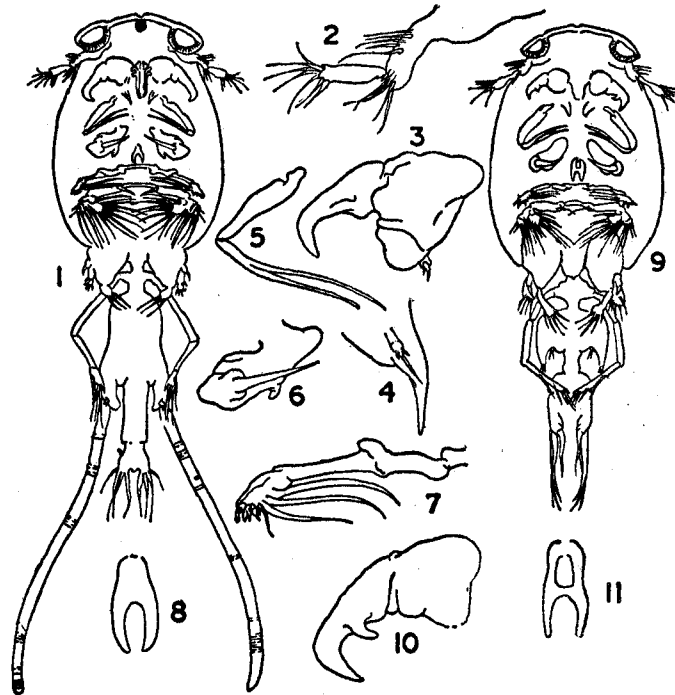


FIG. 12. *Caligus regalis* Leigh-Sharpe. Female. (1) ventral view ; (2) antennule ; (3) antenna ; (4) maxillule ; (5) maxilla ; (6) maxilliped ; (7) first walking leg ; (8) furca ; Male. (9) ventral view ; (10) antenna, and (11) furca (after Leigh-Sharpe).

Scombroid host : *Euthynnus yaito* = [*Euthynnus affinis yaito* Kishinouye].

Locality : Misool, New Guinea Waters, Pacific.

Non-scombroid hosts : None.

Location : On surface of body.

Remarks : The combination of characters which separates this species is : the relatively long antennule ; carapace which is more than half total length ; the bifid terminal spines of distal segment of first legs ; and the nature of the genital segment and abdomen.

Caligus thynni Dana, 1852

(Figure 13 : 1-5)

Description : Female.—Carapace distinctly longer than wide ; lunules small, not prominent ; fourth thoracic segment short and wide ; genital segment longer than broad, with sides divergent, posteriorly widest ; abdomen two-segmented, about equal to genital segment in length,

but its width less than half that of latter; first abdominal segment distinctly shorter than second; egg strings conspicuously narrow, longer than total length, each with about 40 eggs; maxillule lacking; other appendages normal except furca and fourth legs; former with divergent acuminate branches; fourth leg three-jointed with four simple spines.

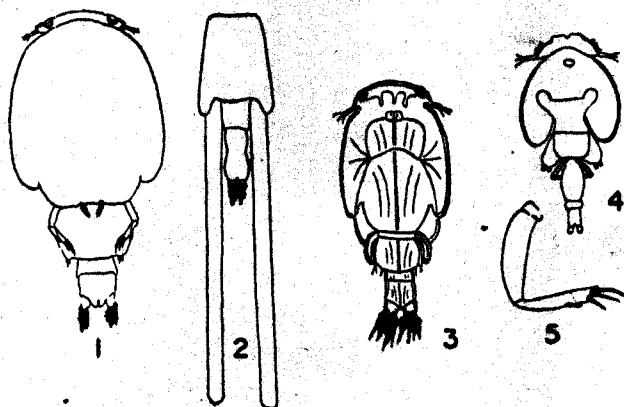


FIG. 13. *Caligus thynni* Dana. Male. (1) dorsal view; Female. (2) dorsal view of genital segment and abdomen; (3) dorsal view of male taken in plankton haul off Philippines; (4) male taken similarly off Falkland Island; (5) fourth leg of same (after Wilson; and Scott).

Male.—Carapace longer than broad, width about three-fourths its length; carapace two-thirds total length; genital segment about 1.5 times wider than long, with convex lateral margins; two pairs of rudimentary legs seen dorsally on posterior side of genital segment; abdomen two-segmented, basal segment about half length of distal; appendages normal but for larger size of antennae and second maxillipeds; fourth legs longer and more slender than in female, with larger and weaker spines.

Scombroid hosts: *Gymnosarda pelamys* [= *Katsuwonus pelamis* (Linnaeus)]
Thynnus pelamys [= *Katsuwonus pelamis* (Linnaeus)]

Locality: North Atlantic.

Non-Scombroid hosts: None. However, taken in plankton hauls from Falkland Islands (Scott, 1914); and West coast of Mindano, Philippines (Wilson, 1950).

Location: ? Probably buccal cavity and gills.

References: Dana (1852); Scott, T. (1894, 1914); Bassett-Smith (1899); Wilson (1905, 1950).

Remarks: Since the specific name is after the host genus *Thynnus* (Wilson, 1905, p. 604) we have followed the emended spelling for the species as given by Scott, T. (1914), and not *C. thymni* as given by Dana, Wilson, and others.

***Caligus* sp.**

(Figure 14: 1-9)

Material examined: A single specimen was obtained along with specimens of *Gloiopterus* from the sailfish *Istiophorus gladius* (Broussonnet) as external parasite from behind the eye. The specimen shows marked differences from known descriptions of species of *Caligus*, but due to the paucity of material it is merely described and designated here only as *Caligus* sp.

Description : Female.—Carapace broader than long, anteriorly narrower, its length slightly less than half total length ; posterior median lobe of carapace broad and its posterior margin in line with posterior ends of broadly rounded lateral lobes ; frontal plates well developed ; lunules large and projecting ; interlunular space of frontal plates about two times lateral diameter

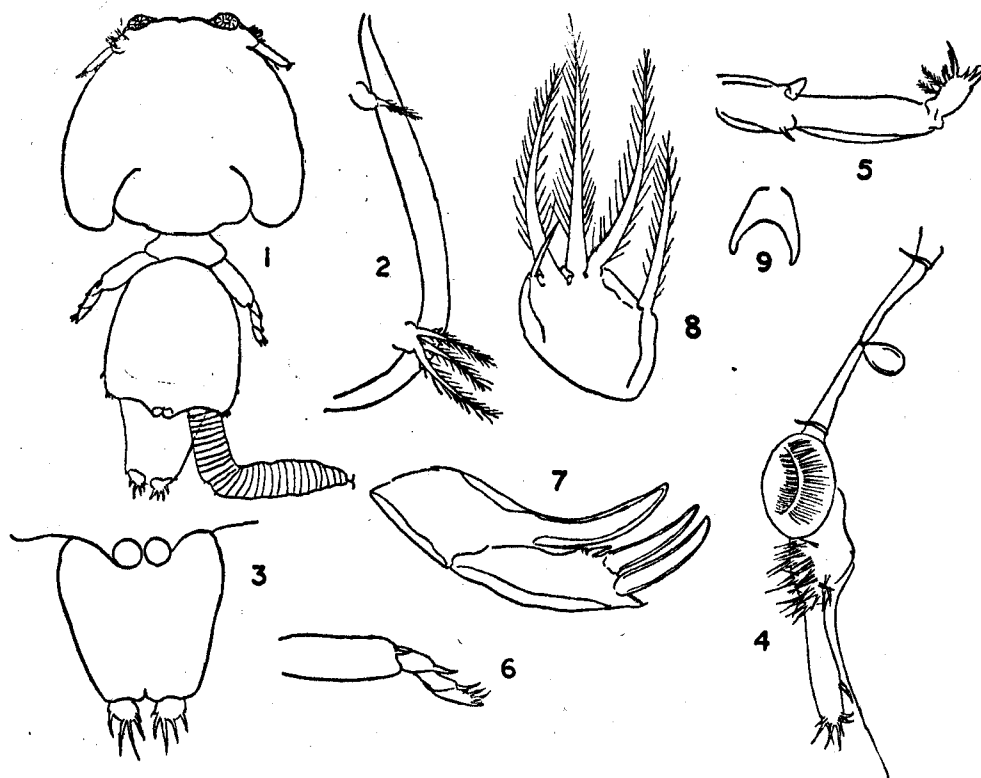


FIG. 14. *Caligus* sp. Female. (1) dorsal view ; (2) ventro-lateral margin of genital segment showing rudimentary fifth and sixth legs ; (3) abdomen ; (4) part of frontal plate, lunule and antennule ; (5) first leg ; (6) fourth leg ; (7) same, terminal part enlarged ; (8) anal lamina ; (9) sternal furca.

of lunule ; fourth thoracic segment short and wide, its length three times its width ; genital segment conspicuously large, slightly longer than broad, posterior margin rounded at angles and medially slightly drawn backwards ending in a sulcus ; genital segment narrower anteriorly ; abdomen one segmented, much broader anteriorly, its width (anteriorly) more than half that of genital segment, while its length is hardly half ; anal laminae short and much broader than long ; bearing four plumose setae and a small inner spine each. Salient features of the appendages are as follows : antennule of two segments, terminal segment slender and about twice length of basal segment ; antennae, maxillules, maxillae and maxillipeds normal ; first pair of legs with terminal spines on distal segment in a graded series, there being three, smallest being innermost ; terminal seta hardly longer than longest spine ; fourth leg four-segmented, but showing variations in number and size of proximal spines on terminal segment on either side [on right side spine rudimentary (Fig. 14 : 7), while on left side it is normally developed] ; rudimentary fifth and sixth legs clearly visible from dorsal side of genital segment ; fifth leg represented by single knob bearing a single plumose seta-like appendage ; sixth legs similar, but each knob carrying three seta-like appendages ; egg strings short, broad, length two and a half times that of abdominal length ; each string with about 25 eggs.

Remarks: As mentioned, our single specimen shows variability in the size of the proximal spine of the distal segment of the first legs. A fuller description can be given only when more material becomes available.

TABLE I

Measurements etc. in 17 species of *Caligus* Müller described from or known to occur on scombroid fishes from various parts of the world (Measurements in mm.)

(F=Female; M=Male)

Species		Total length	Carapace L × W	Genital segment L × W	Abdomen L × W	L. of egg string	No. of eggs
<i>C. alalongae</i>	F.	?					
	M.	?					
<i>C. bonito</i> (A) our material	F.	8.1	2.5 × 2.4	2.1 × 1.7	1.8 × —	..	..
	M.	5.8	2.2 × 2.3	0.8 × 0.64	0.9 × —	..	..
(B) Wilson's (1905)	F.	8.3	3.0 × 3.0	3.0 × —	2.3 × —	8.0	—
	M.	5.5	3.0 × 2.8	1.0 × —	1.2 × —	..	..
<i>C. chelifera</i>	F.	6.0-6.5	3.0 × 2.3	1.6 × —	1.45 × —	3.2	45 to 50
<i>C. coryphaenae</i>	F.	7.0	3.36 × 2.78	1.69 × 1.71	1.57 × 0.64	..	..
	M.	5.65	3.56 × 2.93	1.00 × 1.25	0.71 × 0.56	..	..
<i>C. cybii</i>	F.	?					
	M.	?					
<i>C. germoi</i>	F.	2.6	1.5 × 1.7	0.4 × 0.5	..	..	..
	M.	unknown					
<i>C. infestans</i>	F.	6.0			1		
	M.	4.0					
<i>C. kuroshio</i>	F.	5.55	2.54 × 2.45	1.45 × 1.59	1.14 × 0.41	..	..
	M.	4.69	2.36 × 2.09	0.98 × 0.59	0.91 × —	..	..
<i>C. macarovi</i>	F.	4.61	2.28 × 1.75	1.23 × 1.23	0.93 × 0.50	..	..
	M.	?					
<i>C. mutabilis</i>	F.	5.6	2.3 × 2.2	1.9 × —	1.1 × —	2.5	..
	M.	3.4	1.85 × 1.7	0.7 × 0.43	..	..	..
<i>C. pelamydis</i>	F.	3.3	1.1 × 1.1	0.9 × —	1.2 × —	2.0	30
	M.	2.9					
<i>C. productus</i>	F.	6.0	2.1 × 2.0	1.6 × —	2.0 × —	2.2	30
	M.	4.5	2.2 × 2.2	1.1 × —	1.1 × —	..	..
<i>C. quadratus</i>	F.	5.8	2.04 × 1.89	1.79 × 1.71	1.79 × 0.47	..	..
	M.	3.07	1.71 × 1.46	0.68 × 0.43	0.57 × —	..	..
<i>C. rapax</i>	F.	5.0-7.0	2.6-3.6 × 2.4-3.4	1.5-2.2 × —	1.1-1.5 × —	2.6-3.0	..
	M.	4.0-5.0	2.35 × 2.0	0.75 × —	1.0 × —	..	..
<i>C. regalis</i>	F. & M.	(Not available in original description)					
<i>C. thynni</i>	F.	9.7	4.9 × 3.4	..	..	..	..
	M.	?					
<i>Caligus</i> sp.	F.	5.0	2.2 × 2.5	1.5 × 1.33	0.53 × 0.60	1.6	25

Genus *Anuretes* Heller, 1865

Frontal plates well defined; lunules conspicuous by their absence; maxillae small, simple and straight; second maxillipeds large and powerful; rudiments of fifth pair of legs large and prominent; free thoracic segment small, without dorsal plates; genital segment large, well rounded and emarginate posteriorly; abdomen wanting, but anal laminae attached to ventral surface of genital segment; other characters mostly as in *Caligus*.

Remarks : The genus is known from a few species distributed variously in the Indo-Pacific and Atlantic, but only one is hitherto known from a scombroid host, and that from Indian seas.

Anuretes branchialis Rangnekar, 1953

(Figure 15 : 12-22)

Description : Female.—Carapace elliptical, distinctly longer than broad being more than half length of body ; median lobe of carapace projecting backwards completely covering free thoracic segment ; caudal laminae well separated ; maxillae simple ending in a bluntly conical point ; appendages as shown in figure.

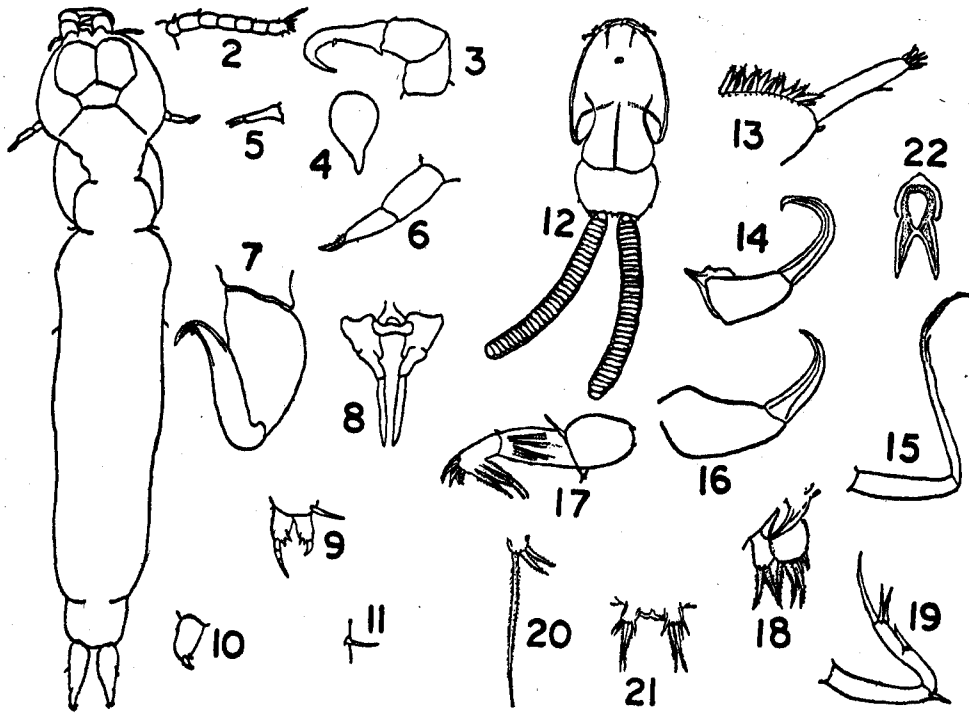


FIG. 15. *Pseudocycnus armatus* Bassett-Smith. 1-11. Male. (1) dorsal view ; (2) antennule ; (3) antenna ; (4) mouth tube ; (5) maxillule ; (6) maxilla ; (7) maxilliped ; (8) first leg ; (9) second leg ; (10) third leg, and (11) fourth leg : *Anuretes branchialis* Rangnekar. 12-22. Female. (12) dorsal view ; (13) antennule ; (14) antenna ; (15) first maxilliped ; (16) second maxilliped ; (17) first leg ; (18) third leg ; (19) fourth leg ; (20) sixth leg ; (21) caudal laminae ; (22) furca ; (after Kirtisinghe ; and Rangnekar).

Measurements (mm.) : Total length excluding egg strings 2.48 ; Carapace length 1.85 ; width 1.20 ; length genital segment 0.85 ; width 1.05 ; length egg strings 2.43-2.45 ; number of eggs, 32 to 35 in each string.

Scombroid host : *Thynnus pelamis* [= ? *Katsuwonus pelamis* (Linnaeus), or ? *Euthynnus affinis affinis* (Cantor)].

Locality : Bombay, India (Arabian Sea).

Non-scombroid host : *Platax teira* (Bombay, India, Arabian Sea : Rangnekar, 1955).

Location : From gill filaments.

Remarks : The scombroid host identification needs confirmation as to whether it is the oceanic skipjack *K. pelamis*, or the little tunny *E. a. affinis*, which commonly occurs along the Indian coast and is also landed at Bombay.

In the only other species known from this area, *A. perplexus* Bassett-Smith, 1898 (Trincomalle, Ceylon), the carapace is broader than long, as in *A. brevis* Pearse, 1951 (male) from Bahamas, Atlantic. The last said is suspected to be the male of *A. heckelii* Kroyer (1863) or *A. parvulus* Wilson (1913), both known from the Atlantic. Besides these, the genus is known from two other species described by Shiino (1954) from Japanese waters.

Genus *Lepeophtheirus* Nordmann, 1832

Differs from *Caligus*, but resembles *Anuretes* in the absence of lunules; but differs from latter in having an abdomen which is one or two segmented, and the maxillae being small and bifurcate.

Lepeophtheirus dissimulatus Wilson, 1905

(Figure 16 : 1-18)

Description : *Female*.—Carapace orbicular, as wide as long; frontal plates large, well defined; median posterior lobe of carapace broad, truncate, half carapace width, projecting slightly backwards beyond tips of lateral lobes; fourth thoracic segment short, one-third width of genital segment; latter almost spherical, width more than half that of carapace; from rounded posterior margin of dorsal surface opposite each egg tube projects a short conical papilla without setae or spines; ventrally a pair of larger papillae one on each side of abdomen and each carrying three plumose setae, probably representing fifth legs; abdomen small, less than one-third length of genital segment and attached to ventral surface of latter, and not visible when seen from dorsally; single abdominal segment three-fifths as wide as long; anal laminae 0.75 length of abdomen, half as wide as long and bearing four elongate plumose setae longer than abdomen and laminae together; egg strings short, broad, each carrying 15 to 25 eggs; terminal segment of antennule longer than basal; terminal hook of antenna strongly curved; maxillule and maxilla represented by a pair of strongly curved and a pair of nearly straight spines respectively; other appendages as figured.

Male.—Carapace as in female; free thoracic segment larger, as wide as genital segment and half as long; bases of fourth legs protruding prominently as in female; genital segment elliptical, about as wide as long; truncate posteriorly; fifth legs represented as pair of prominent papillae projecting from postero-lateral margins of genital segment, each papilla carrying three long spines; abdomen one-segmented, short, wider than long; plumose setae on anal laminae relatively long; antennae much longer than in female and branched 'like stag's horn'; fourth leg much larger and stouter; other appendages as in female.

Measurements (mm.) : *Female (Male)*.—Total length 3.5 (2.5); length \times width of carapace 2.3 \times 2.3 (1.7 \times 1.7); length of genital segment 1.0 (0.37); length of abdomen (0.2); length of egg string 2.0 mm.

Scombroid hosts : *Thynnus pelamys* [= *Katsuwonus pelamis* (Linnaeus)].
'Mackerel' [= *Scomber japonicus* sub. sp.].

Locality : E. Pacific (See Shiino, 1959e).

Non-Scombroid hosts : *Epinephelus morio* (Bermuda, Atlantic) ; *Paralichthys californicus*, *Hypsopsetta guttulata*, *Sphyræna argentea* (Ensenada, Baja California, Mexico) ; *Paralabrax nebulifer* (Cholla Bay near Puerto Penasco, Sonora) ; ? *Sphaeroides annulatus* (Guaymas, Sonora) ;

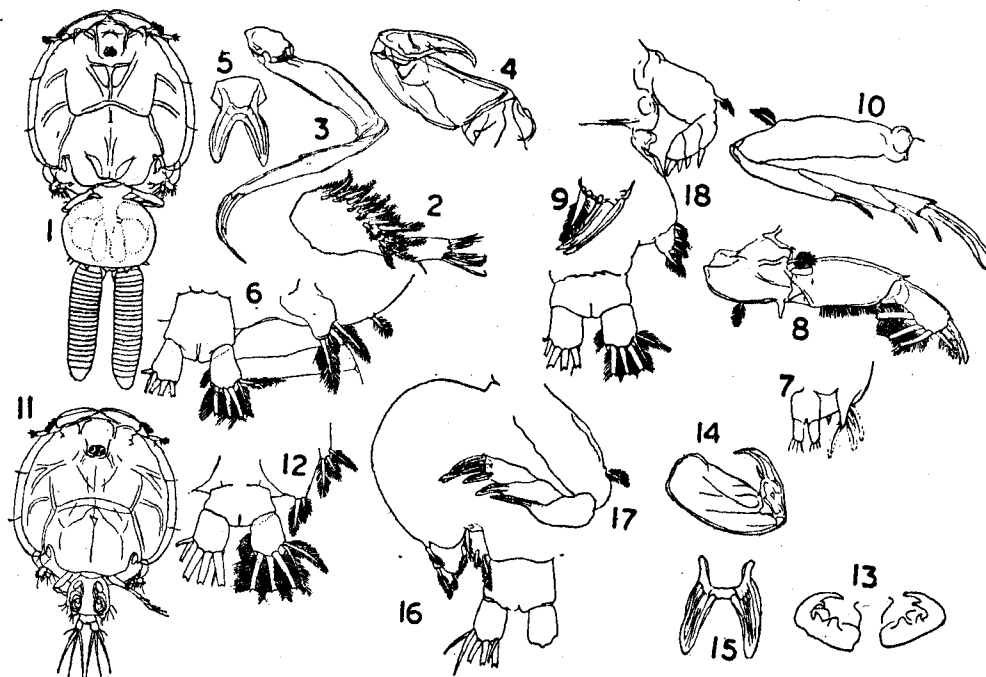


FIG. 16. *Lepeophtheirus dissimilatus* Wilson. Female. (1) dorsal view; (2) antennule; (3) first maxilliped; (4) second maxilliped; (5) sternal furca; (6) abdomen and part of genital segment, showing rudimentary fifth leg; (7) same-Bermuda specimen; (8) first leg; (9) same terminal part; (10) fourth leg; Male. (11) dorsal view; (12) abdomen and part of genital segment showing rudimentary fifth legs; (13) antennae; (14) maxilliped; (15) sternal furca; Young female. (16) part of genital segment and abdomen; (17) fourth leg; (18) fourth segment, and abdomen of young female (7 and 13 after Wilson; others after Shiino).

Galeichthys guatemalensis ? (Mazatlan, Sinaloa, Mexico) ; *Bodianus diplotaenia* (Socorro Island, Revillagigedo Archipelago, Mexico) ; *Epinephelus labriformis* (Charles Island, Galapagos) ; *Epinephelus labrifrons* (Clarion Island, Revillagigedo Archipelago, Mexico) ; *Epinephelus* sp., *Lactophrys triquetter*, *Mycteroperca olfax*, *M. xenarcha*, *Mycteroperca* sp., *Cratinus agassizii*, and *Paralabrax hameralis* (See Shiino, 1959 e).

Location : On outer surface of body.

References : Wilson (1905) ; Shiino (1959 e) ; Causey (1960).

Remarks : The species is most distinct of all members of the genus in the following character : in the extremely small and 'concealed' abdomen which is ventral to the egg strings. Shiino's figure does not show the 'stag's horn-like' branching of the antennae of the male noted by Wilson (1905) ; Shiino's specimens appear to have four instead of three marginally arranged plumose setae on the rudimentary fifth legs, the disposition of the setae itself (in females) being characteristic for the species.

Lepeophtheirus eminens Wilson, 1944

(Figure 17: 1-8)

Description. *Female*.—Carapace elliptical, longer than broad, more than half total length; posterior median lobe extending behind level of tips of lateral lobes; fourth thoracic segment short, narrower than genital segment, width being hardly one-third carapace width; genital segment broader than long, provided with posterior lateral lobes, one on each side; abdomen two-segmented, but segmentation indistinct; length as long as genital segment, width 2.5 times in width of latter; anal laminae fused with abdomen, about as wide as long carrying five setae each, middle one being longest; appendages normal; furca more or less H-shaped.

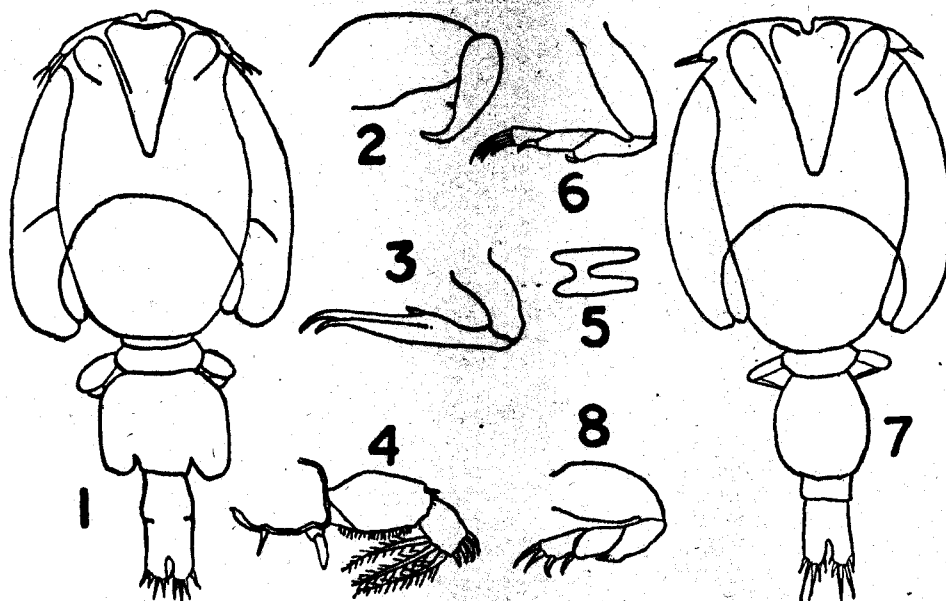


FIG. 17. *Lepeophtheirus eminens* Wilson. *Female*. (1) dorsal view; (2) maxilliped; (3) second maxilla; (4) first leg; (5) furca; (6) fourth leg; *Male*. (7) dorsal view; (8) fourth leg of male (after Wilson).

Male.—Carapace and fourth thoracic segment as in female, but latter less wider, width being about 3.5 in carapace width; genital segment elliptical, slightly longer than wide; length greater than that of abdomen and 3.25 in carapace length; abdomen two-segmented, half as wide as long, basal segment much shorter than distal; anal laminae fused with latter and bearing setae; other appendages as in female except fourth legs which are stout, short, with combined length of three distal segments equalling that of basal segment; spine at distal corner of second segment short, strongly curved; three terminal spines of unequal lengths.

Measurements (mm.) ∴ *Female (Male)*.—Total length 6.0 (6.0); length of carapace × width 3.95 × 3.0 (3.66 × 3.15).

Scombroid host : *Makaira ampla marlina* 'the black marlin' [= *Makaira indica* (Cuvier)]

Locality : Ventura, Baja California, Mexico, Pacific.

Non-scombroid hosts : None.

Location : Outside surface of body.

Remarks : In Royce's review of the Pacific spearfishes, the 'black marlin' is denoted as *Istiompax marlina* (Jordan and Hill) which is a synonym of *I. indicus* (Cuvier).

Characters of specific importance of *L. eminens* are the posteriorly lobed genital segment and fusion of abdominal segments in female and fusion of anal laminae with abdomen in both sexes.

Genus *Alicalgus* Shiino, 1955

Alicalgus tripartitus Shiino, 1955

Scombroid host : *Sarda orientalis* (Temminck and Schlegel).

Locality : Japan, Pacific.

Non-scombroid hosts : None.

Location : ? Gills.

Remarks : We have not seen the original description of this species as given by Shiino (1955).

Genus *Parapetalus* Steenstrup and Lutken, 1861

? *Parapetalus* sp.

(Figure 18 : 1-8)

A single female specimen was obtained from the buccal cavity of the oriental bonito, *Sarda orientalis* (Temminck and Schlegel) from the south west coast of India (Vizhingam) in September 1960. In several characteristics the specimen differs from *Caligus*, and neither does it belong strictly under *Parapetalus*, but due to the lateral expansions of the genital segment and abdomen, it is provisionally described under the latter genus without species designation. We are unable to comment on *Alicalgus* Shiino as we have not seen the description given by Shiino, but *Alicalgus tripartitus* Shiino, and our ? *Parapetalus* sp. are found on the same host, *Sarda orientalis* (Temminck and Schlegel).

Description : *Female*.—Carapace slightly longer than broad; posterior median lobe broadly rounded, posterior margin extending slightly behind level of hind margins of lateral lobes; frontal plates broad; lunules conspicuous, lateral dimensions equalling half interlunular distance; fourth segment short and narrow without dorsal plates; genital segment conspicuously large, much broader than carapace, but in length slightly less; posterior margins of genital segment undulating with an incipient broader median lobe; anteriorly genital segment is constricted where it joins the fourth thoracic segment; abdomen apparently two-segmented, segmentation indistinct, length two-fifths total length; first segment more or less spindle-shaped and seven times as long as terminal segment and three times wider; greatest width of basal segment half width of genital segment; anal laminae as long as terminal abdominal segment, each bearing four plumose setae and two minute spines; egg strings broad and long, being equal to combined length of genital and abdominal segments; each string containing about 50 eggs.

Salient features of appendages are: antennule short, two-segmented, segments of about equal length and together equal lateral dimension of lunule; antenna, maxillule, maxilla, maxilliped and furca as in *Caligus*; first pair of legs with terminal segment carrying three long setae laterally and terminally four spines arranged more or less in a row of varying lengths; basal parts of setae flattened with coarse bristles resembling denticulations along outer margin, inner margin lacking such bristles; remaining part of setae furnished with fine setules along both margins;

fourth leg short; segmentation of terminal part differs being indicated only by irregular constrictions; five large broadly flattened plumose setae of which four occur along outer lateral margin and one terminally; at base of each lateral seta a slender spinuous process carrying long fine straight comb-like setules present; inner base of terminal seta is elevated into a denticulated process.

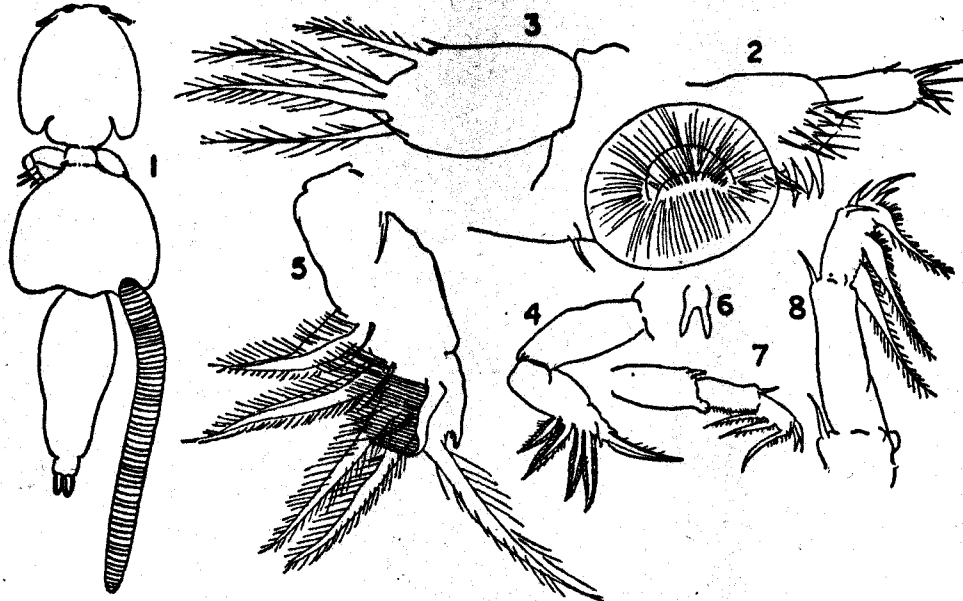


FIG. 18. ? *Parapetalus* sp. Female. (1) dorsal view; (2) antennule and lunule; (3) anal lamina; (4) fourth leg; (5) same, terminal part enlarged; (6) sternal furca; (7) first leg; (8) same, terminal part enlarged.

Remarks: The diffuse segmentation and the non-spinuous appendages carried by the distal half of the fourth legs is another feature which distinguishes the specimen from *Caligus*, besides nature of genital segment and abdomen already mentioned.

FAMILY: EURYPHORIDAE

Genus *Alebion* Kroyer, 1863

Lunules absent; fourth segment with dorsal plates in female, which are much reduced or lacking in male; genital segment in female usually produced into long lateral posterior processes, extending backwards beyond tip of abdomen; males with genital segment smoothly rounded; abdomen two-segmented in both sexes, basal segment in female with long processes at its posterior corners; first three pairs of legs biramous, exopod with very large claws; rami of first pair two-segmented, of second and third pairs three-segmented; fourth leg rudimentary, consisting of a single segment; no furca or maxillary hook; genital segment of male often carrying leg rudiments.

Alebion glaber Wilson, 1907

(Figure 19: 1-10)

Description: Female.—Carapace orbicular, as long as broad, slightly less than half total length; fourth segment nearly as wide as genital segment; dorsal plates small and rounded;

genital segment squarish, width half that of carapace; no leg rudiments seen; basal segment of abdomen bulbous, but equal in length to terminal segment; fourth leg rudimentary, single-segmented, three times as long as wide and carrying three terminal spines; egg strings longer than total length.

Male.—Carapace longer than wide, ovate; fourth thoracic segment long, narrow, slightly more than half width of genital segment, dorsal plates rudimentary; genital segment barrel-shaped, with posterior corners ending in divergent protuberances; fifth pair of legs visible at mid-lateral part of genital segment; basal abdominal joint shorter than terminal.

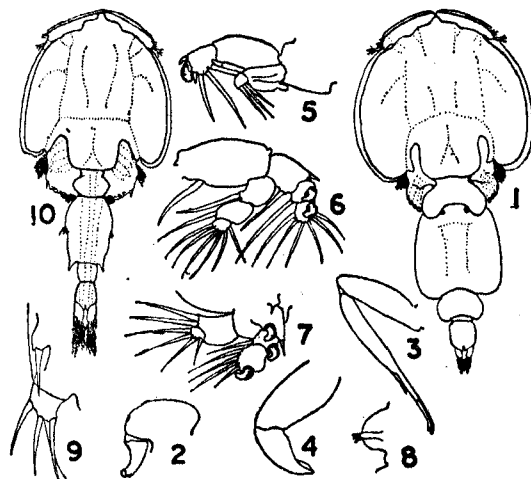


FIG. 19. *Alebion glaber* Wilson. *Female*. (1) dorsal view; (2) antenna; (3) first maxilliped; (4) second maxilliped; (5-8) first to fourth legs; (9) rudimentary fifth legs; *Male*. (10) dorsal view (after Wilson).

Measurements (mm.): *Female* (*Male*).—Total length 10-12 (7.0-7.75); length of carapace \times width 5.9 \times 6.0 (3.5 \times 3.1); length \times width of genital segment 3.1 \times 3.0 (1.25 \times 1.1); length of abdomen 2.5 (1.35); length of egg string 15 mm.

Scombroid host: 'Bonito' [= *Sarda sarda* (Bloch)]

Locality: Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic).

Non-scombroid hosts: *Mustelus canis*, *Carcharius littoralis*, and *Squalus acanthias* (Woods Hole, Massachusetts, U.S.A.).

Location: External surface of body.

References: Wilson (1907, 1932); Sumner *et al.* (1913).

Remarks: The quadrangular shape of the genital segment which is different from other members of the genus helps in easily distinguishing this species.

***Alebion gracilis* Wilson, 1905**

(Figure 20: 1-13)

(Syn. *Alebion gracile* Wilson, 1905).

Description: *Female*.—Carapace broadly ovate, longer than wide, fourth thoracic segment slightly less wide than genital segment and half as long; dorsal plates of fourth segment projecting backwards partly overlapping genital segment; latter, one-half times broader than

long, with postero-lateral corners produced into greatly elongate conical processes as given for genus; inner margins of these projections with minute spines; basal abdominal segment with similar, but lobular lateral projections; terminal segment squarish and longer than anal laminae; egg strings slightly shorter than total length.

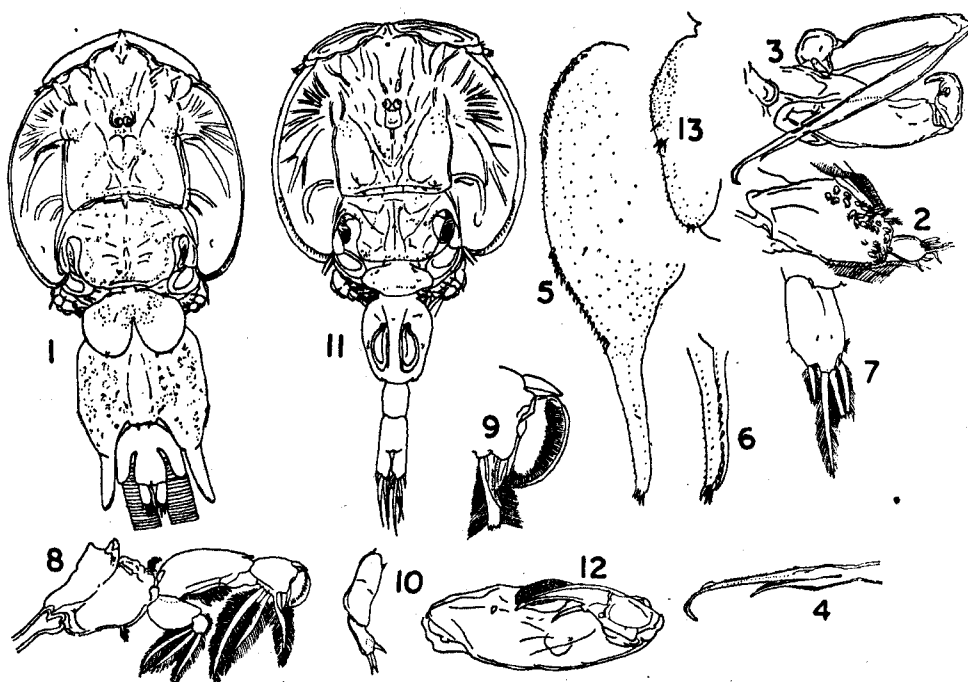


FIG. 20. *Aleblon gracilis* Wilson. Female. (1) dorsal view; (2) antennule; (3) first and second maxillipeds; (4) tip of first maxilliped; (5) posterior process of genital segment (ventral view); (6) same, dorsal view; (7) anal lamina; (8) first leg; (9) tip of exopod of first leg; (10) fourth leg; Male. (11) dorsal view; (12) maxilliped; (13) part of genital segment showing rudimentary legs (after Shiino).

Male.—Carapace slightly broader than long; fourth thoracic segment as wide as genital segment; dorsal plates rudimentary; genital segment slightly longer than broad, widest at centre with convex lateral margins; a pair of leg rudiments visible ventrally; abdominal segments of more or less equal dimensions, but without lateral processes as in female.

Measurements (mm.): Female (Male).—Total length 9.0-10.0 (5.0-6.0); length of carapace \times width 5.35 \times 4.9 (3.0 \times 3.2); length of genital segment \times width 3.5 \times 2.66 (1.35 \times 0.9); length of abdomen 1.67 (1.4); egg strings 9.0 mm.

Scombroid host: 'Bonito' [= *Sarda sarda* (Bloch)].

Locality: Massachusetts coast, U.S.A. (N.W. Atlantic).

Non-scombroid hosts: *Mustelus canis*, *Carcharhinus littoralis*, *Trygon* sp. (= ? *Dasyatis centrura*), *Pollachius virens* (Woods Hole, Massachusetts, U.S.A., N.W. Atlantic); *Carcharinus platyrhynchus* (Clarion Island, Revillagigedo Archipelago, Mexico, E. Pacific); *Carcharinus lamiella* (Socorro Island, Revillagigedo Archipelago, Mexico, E. Pacific).

Location: External surface of body.

References: Wilson (1905, 1907, 1932); Sumner *et al.* (1913); Shiino (1959e).

Remarks : A few minor differences are noticeable between the Atlantic and Eastern Pacific material described by Wilson and Shiino respectively. These are : shape of the dorsal plates of the fourth thoracic segment in the females ; abdominal segmentation distinct in Atlantic specimens ; terminal segment of endopod of first leg with three plumose setae along its inner margin in the Pacific form instead of a single seta found in those from the Atlantic.

Genus *Elytrophora* Gerstaecker, 1853

Differing from *Alebion* chiefly in : 1. first four pairs of legs biramous ; rami of first pair two-segmented, of second and third pairs three-segmented, exopod of fourth pair three-segmented and endopod two-segmented ; 2. fifth leg rudiments present in male ; 3. a furca present ; and 4. no maxillary hook.

***Elytrophora atlantica* Wilson, 1932**

(Figure 21 : 6-15)

Description : Female.—Carapace orbicular, a little wider than long ; fourth thoracic segment forming a short narrow waist anteriorly and provided with elliptical dorsal plates, inclined towards each other and overlapping at their tips ; outer margin of each plate invaginates near its centre ; genital segment barrel-shaped with broad posterior lobes curved inward over basal abdominal segment ; first abdominal segment longer than second, with tiny lobes at its posterior corners ; anal laminae shorter than terminal segment ; egg strings about same as total length ; furca thrice as long as wide, basal half stout with convex sides, branches slender and slightly incurved ; leg rudiments absent in genital segment.

Male.—Carapace as in female ; dorsal plates of fourth thoracic segment with knob-like projections at each anterior corners and no invaginations on outer margins ; genital segment elliptical without posterior lobes, but with leg rudiments on lateral margins just behind mid-length ; abdominal segments of equal dimensions, first segment without posterior lobes ; antennae showing sexual dimorphism.

Measurements (mm.) : *Female (Male).*—Total length 8.0-9.0 (6.0-6.5) ; width of carapace 4.0-4.5 (2.5-3.0).

Scombroid host : *Thunnus thynnus* [= *Thunnus (Thunnus) thynnus thynnus* (Linnaeus)].

Locality : Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic).

Non-scombroid hosts : None.

Location : Gills.

Remarks : Wilson (1932) mentions that his material was obtained from the gills of the 'horse mackerel (*Thunnus thynnus*)'. It may be mentioned here that generally the popular name 'horse mackerel' is applied to the Carangid fish *Trachurus trachurus* (Linnaeus) or some allied carangids.

***Elytrophora brachyptera* Gerstaecker, 1853**

(Figure 21 : 1-5)

(Syn. *Arnaeus thynni* Kroyer, 1863 ; ? *Dinematura thynni* Kollar, 1835).

Description : Female.—Carapace orbicular, hardly half total length ; fourth thoracic segment carrying two small kidney-shaped plates, each in turn lobed ; posterior lobes of each plate slightly overlapping genital segment ; latter distinctly longer than wide, with posterior corners

lobular; abdomen hardly half length of genital segment; first abdominal segment with postero-lateral corners slightly projecting backwards; second segment globular; anal laminae distinctly longer than wide and slightly expanded distally bearing five apical plumose setae; appendages as figured.

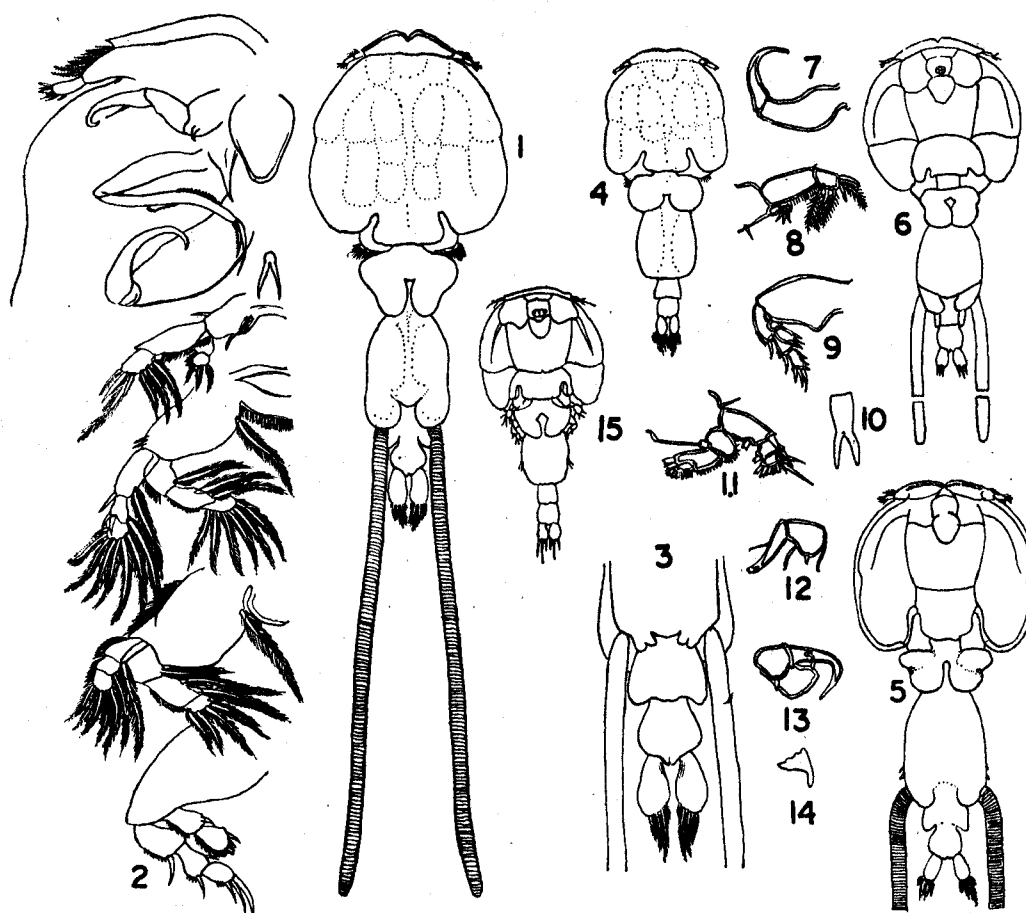


FIG. 21. *Elytrophora brachyptera* Gerstaecker. 1-5. *Female*. (1) dorsal view; (2) cephalic and thoracic appendages *in situ*; (3) genital segment and abdomen, ventral view; *Male*. (4) dorsal view; *Female*. (5) dorsal view of specimen from British Seas (1-4 after Heller; 5 after Scott and Scott). *Elytrophora atlantica* Wilson. 6-15. *Female*. (6) dorsal view; (7) maxilliped; (8) first leg; (9) fourth leg; (10) sternal furca; (11) second legs; (12) second antenna; *Male*. (13) second antenna; (14) maxilla; (15) dorsal view of male (after Wilson).

Male.—In general like female, except smaller size; genital segment rather squarish; two-segmented abdomen about as long as genital segment; postero-lateral corners of first abdominal segment angular and produced backwards as in female; second maxillipeds more powerfully clawed.

Measurements (mm.): *Female (Male)*.—Total length 10.0-11.5 (9.0).

Scombroid hosts: 1. *Orcynus thynnus* [= *Thunnus (Thunnus) thynnus thynnus* (Linnaeus)]
 2. *Thynnus vulgaris* [= -do-]
 3. *Thynnus thynnus* [= -do-]

4. *Thynnus orientalis* [= *Thunnus* (*Thunnus*) *thynnus orientalis* (Temminck and Schlegel)]
5. *Neothunnus albacora* [= *Thunnus* (*Neothunnus*) *albacares macrop-terus* (Temminck and Schlegel)]
6. *Parathunnus obesus* [= *Thunnus* (*Parathunnus*) *obesus mabachi* (Kishinouye) or *T. (P.) obesus sibi* (Temminck and Schlegel)]
7. *Thynnus alalonga* [= *Thunnus* (*Thunnus*) *alalonga* (Bonnaterre)]

Localities : 1-3. Mediterranean, Atlantic ; 4-7. Japan, Pacific.

Non-scombroid hosts : None. Heegaard (1955) has reported on six young specimens (size about 6 mm.) taken at surface by 'ATLANTIDE' off Tropical West Africa (20° 04' N, 22° 33' W).

Location : Gills of host species.

References : Gerstaecker (1853) ; ? Kollar (1835) ; Kroyer (1863) ; Heller (1865) ; Bassett-Smith (1896) ; Scott and Scott (1913) ; Heegaard (1955) ; Shiino (1954, 1957).

Remarks : There appears to be slight differences in the figures of the female of *E. brachypters* given by Heller (1865) and Scott and Scott (1913), which can be seen from said figures reproduced here (Figure 21). Shiino (1959b) considers *E. brachyptera* of Yamaguti (1936) from Japan a synonym of Wilson's (1921) *E. hemiptera*.

***Elytrophora hemiptera* Wilson, 1921**

(Syn. *Elytrophora brachyptera* Yamaguti, 1936 *nec* Gerstaecker, 1853).

- Scombroid hosts* :
1. *Thunnus thynnus* (= *Thynnus orientalis*) [= *Thunnus* (*Thunnus*) *thynnus orientalis* (Temminck and Schlegel)]
 2. *Neothunnus albacora* [= *Thunnus* (*Neothunnus*) *albacares macrop-terus* (Temminck and Schlegel)]

Localities : 1. Owase, Mie Prefecture and Hamajima, Japan, Pacific ; 2. Owase, Mie Prefecture, Japan.

Non-scombroid host : *Isurus glaucus* (Owase, Mie Prefecture, Japan).

Location : Gill cavity.

References : Wilson (1921) ; Yamaguti (1936) ; Shiino (1958, 1959b).

***Elytrophora indica* Shiino, 1958**

Scombroid host : *Makaira mitsukurii* [= *Makaira audax* (Philippi)].

Locality : Bay of Bengal (12° 50' N, 81° 19' E).

Non-scombroid hosts : None.

Location : Gills.

Genus *Euryphorus* Nordmann, 1832

Wilson (1932) distinguishes *Euryphorus* from *Elytrophora* as follows :

'Abdomen twice as long as genital segment, its basal segment 10 times as long as terminal segment ; genital segment wider than carapace ; gill cavity of fishes ;

(Female only).....*Euryphorus* Milne Edwards'

'Abdomen much shorter than genital segment, its two segments about the same length ; genital segment less than half as wide as carapace ; outside of fishes ;

(male and female).....*Elytrophora* Gerstaecker'

Euryphorus nympha Steenstrup and Lutken, 1861

(Figure 22 : 1-3)

(Syn. *Euryphorus coryphaenae* Kroyer, 1863 ; *Euryphorus nordmanni* Kirtisinghe, 1937 ; For detailed synonymy see Shiino, 1954).

Scombroid host : 1. *Thunnus alalunga* [= *Thunnus* (*Thunnus*) *alalunga* (Bonnaterre)].

2. *Neothunnus albacora* [= *Thunnus* (*Thunnus*) *albacares macropterus* (Temminck and Schlegel)].

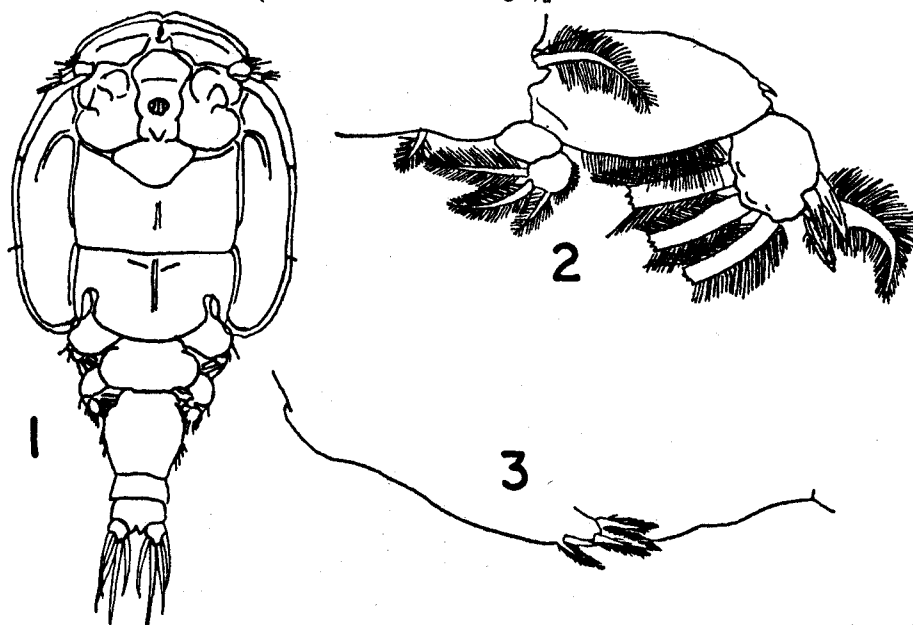


FIG. 22. *Euryphorus nympha* Steenstrup and Lutken. Young male. (1) dorsal view ; (2) first leg ; (3) part of genital segment (after Shiino).

Locality : 1. Indian Ocean (6° 52' S, 74° 49' E.) ; 2. Pacific.

Non-Scombroid hosts : *Coryphaena hippurus* (Pacific ; Indian Ocean ; and Atlantic) ; *Lamugus punctatus* (See Shiino, 1959a) ; *Rachycentron canadus* and *Coryphaena hippurus* (Causey, 1953, a, b).

Location : Gill cavity.

References : Steenstrup and Lutken (1861); Kirtisinghe (1937); Kroyer (1863); Shiino (1954, 1958, 1959a, b); Causey (1953, a, b).

Remarks : Figure 22 after Shiino (1959a) will give details about the male of *E. nymphe*.

For further discussion see 'Addendum'.

Genus *Gloiopotes* Steenstrup and Lutken, 1861

Carapace as in Caligidae; lunules absent; a pair of dorsal plates on genital segment which slightly overlap genital segment and basal segments of fourth legs; genital segment in female produced at each posterior corner into a curved process bearing a serrated styliform appendage on its outer margin; in males curved posterior process of genital segment absent, but styliform process attached to posterior corners of genital segment; two-segmented abdomen slender; caudal laminae filiform; first and fourth legs uniramous, second and third biramous, rami three-segmented; terminal claws of first legs tripartite; furca compound, its branches bifid.

Gloiopotes costatus Wilson, 1919

- Scombroid host* :
1. 'Swordfish' [= *Makaira* sp.]
 2. *Istiophorus greyi* [= *Istiophorus gladius* (Broussonnet)]
 3. *Makaira* sp.

Localities : 1. Catalina Island off California (Pacific); 2. Guaymas, Sonora and Mazatlan, Sinaloa. Mexico (Pacific); 3. Acapulco, Guerrero, Mexico (Pacific).

Non-scombroid hosts : None.

Location : On outer surface of body.

References : Wilson (1919); Causey (1960).

Remarks : As Causey (1960) suggests, Wilson's use of quotation for 'swordfish' indicates some doubts as to the host. Along the Mexican Pacific coast the species is said to be quite common on marlins and sailfish and the 'blue bodies and red egg strings are quite conspicuous.' Further, Causey found a specimen from the sailfish (at Mazatlan) with a barnacle *Conchoderma* sp. upon it.

Gloiopotes ornatus Wilson

(Figure 23 : 1-6)

Description : *Female*.—Carapace distinctly longer than wide, half total length; posterior median lobe broad, very slightly emarginate, carrying ten symmetrically arranged spines on lateral and posterior margins on each side; fourth segment short, wide, length about 3.5 in width; latter as broad as genital segment behind and 2/3rd as broad as carapace; dorsal plates broadly lobular, smooth; genital segment much broader than long, anteriorly constricted into neck; styliform appendage from posterior process of genital segment carrying a number of spines along inner margin; genital segment having on its dorsum and lateral margins several spines more or less symmetrically disposed; two-segmented abdomen cylindrical, basal segment

squarish, terminal segment longer than broad with slight constriction just behind its mid-length ; both segments with spines along dorsum, in addition terminal segment with spines along lateral margins also ; anal laminae two-thirds second abdominal segment, proximal one-third length much wider than distal two-thirds ; antennule with terminal joint longer than basal ; antenna with broad basal segment and stout terminal claw which carries an accessory spine at its mid-length ; furca as for genus ; first pair of legs with two inner claws on terminal joint being trifurcate ; outermost claw long and pointed ; rami of third pair of legs close together, outer ramus armed with bifurcate claws ; fourth legs large, basal segment stout, broad and exceeding length of three distal segments ; first two distal segments carry one spine, while terminal segment has three ; all three segments carry a fringe of small spines along outer margin ; fifth legs wanting.

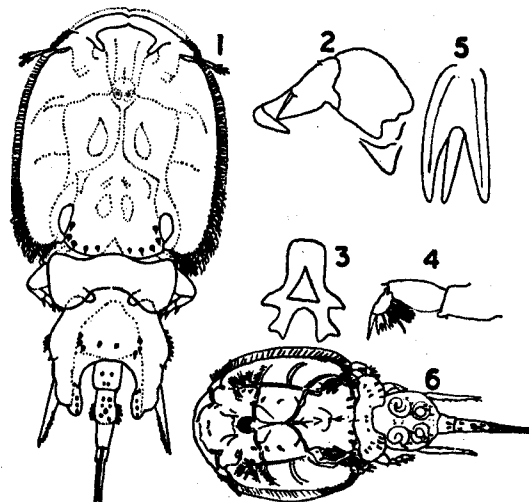


FIG. 23. *Gloiopotes ornatus* Wilson. Female. (1) dorsal view ; (2) antenna ; (3) furca ; (4) first leg ; (5) trifurcate spine of terminal segment of first leg. Male. (6) dorsal view. (1-5, after Wilson ; 6, after Shiino).

Male.—Carapace as in female ; dorsal plates of fourth thoracic segment considerably wider than genital segment ; posterior margin with median sinus, with four spines on either side along posterior border ; genital segment as wide as long with a pair of spines on either side of mid-line dorsally ; an irregular row of 8 spines along posterior margin along dorsal surface ; each styliform process arising directly from genital segment, reaching level of hind end of second abdominal segment, and tipped with three minute spines ; terminal segment of abdomen twice as long as basal segment ; both segments with parallel lateral sides and few small spines along dorsum ; anal laminae as long as entire abdomen, laterally flattened, closely adpressed, each bearing single seta.

Measurements (mm.): Female (Male).—Total length 10.0-12.0 (8.0) ; Carapace length \times width 5.4×4.6 ; length of genital segment including posterior process 3.4 ; length of abdomen 3.2

Scombroid host : 1. 'Swordfish' [= *Xiphias gladius* Linnaeus].

2. *Tetrapterus imperator* [= *Tetrapturus belone* Rafinesque ; *T. imperator* Schneider is now recognised as a synonym of *Xiphias gladius*, being based on an illustration of a young of the latter species. However, in this case the reference is to *T. belone*]

3. *Makaira mitsukurii* [= *Makaira audax* (Philippi)]

Locality : 1. & 2. Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic) ; 3. Recife, Brazil (Atlantic : See Shiino 1959b).

Non-scombroid hosts : None.

Location : On outer surface of body.

***Gloiopotes hygomianus* Steenstrup and Lutken, 1861**

(Figure 24 : 1-23)

Description : Female.—Carapace longer than broad, narrowing anteriorly, and half total length ; dorsal plates of fourth thoracic segment greatly enlarged, narrowed in its insertion to carapace, plates about half as long as carapace and overlapping half genital segment, both plates separated by deep cleft, but fused on dorsum of fourth segment ; genital segment wider than half width of carapace, little wider than its own length at mid-line, carrying at hind end a pair of elongated processes ; latter extending parallel to but for some distance beyond end of abdomen ; each process bears in front of their blunt end a postero-laterally projecting flattened lobe with pointed apex ; sides of genital segment as well as these postero-lateral lobes bear minute spinules on lateral and posterior margins ; two-segmented abdomen cylindrical, first segment short, half as long as terminal segment, but slightly wider ; both segments provided with minute spinules dorsally. Appendages as shown in figure, notable differences from *G. ornatus* being in the structure of the furca ; external spines on exopod of second leg with narrow rims on two opposite borders, that of first joint associated at its base with a transverse row of short spinules ; in addition, anal laminae about half abdominal length, each bearing three unequal terminal spines, and one solitary spine externally at proximal one-third length ; spinules irregularly present on anal laminae.

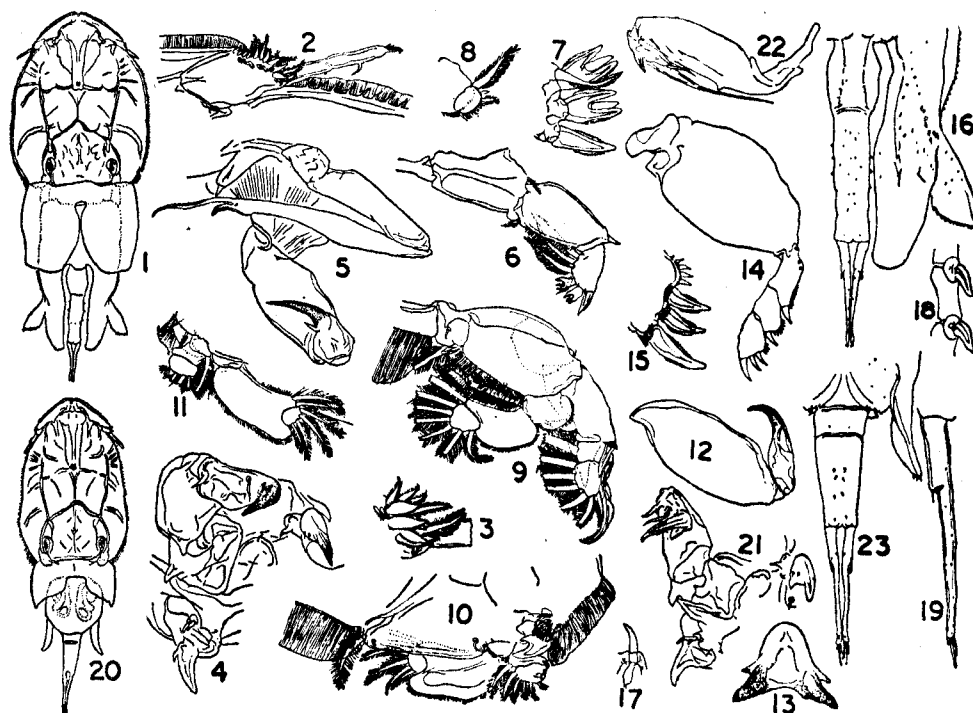


FIG. 24. *Gloiopotes hygomianus* Steenstrup and Lutken. *Female*. (1) dorsal view ; (2) antennule ; (3) same distal part of first joint ; (4) antenna and maxilla ; (5) first and second maxillipeds ; (6) first leg ; (7) apical spines of same ; (8) tip of endopodite of same ; (9) second leg ; (10) third leg ; (11) two rami of same posterior side ; (12) second maxilliped ; (13) sternal fork ; (14) fourth leg ; (15) terminal end of same ; (16) postero-lateral lobe of genital segment and abdomen, ventral view ; (17) spinule on the surface of carapace ; (18) marginal spines of genital segment ; (19) anal lamina ; *Male*. (20) dorsal view ; (21) antenna and maxilla ; (22) second maxilliped ; (23) postero-lateral process of genital segment and abdomen (after Shiino).

Male.—Carapace much narrower than in female, two-thirds as wide as long ; dorsal plates of fourth thoracic segment far smaller than and different in shape from that of female ; four-

fifths as wide as carapace in their combined width, foliaceous, and acuminate postero-laterally and overlapping succeeding segment only in antero-lateral angles, and separated from each other by a broad quadrate median sinus; genital segment about one-third as long as carapace, as long as wide, carrying from postero-lateral angles two styliform processes; latter extending beyond first abdominal segment, and tipped by three short spinules; genital segment and its processes without marginal spinules; basal segment of abdomen one-third as long as second; anal laminae about equal to length of abdomen; antennule better developed than in female; antennae more geniculate; maxillule bears a short inner spiniform accessory process; such branching absent in maxilla; base of second maxilliped slender than in female and armed with short conical processes on inner border; claw elongate tapering distally to terminate into a thin circular, but well chitinized apex which carries a short conical process on upper surface near base in addition to ordinary accessory spine.

Measurements (mm.): Female (Male).—Total length 13.66 (8.27); length of carapace \times width 6.61×5.45 (4.73×3.20); fourth thoracic segment on mid dorsal line 0.98 (0.53); same including dorsal plate 3.57×4.55 (1.47×2.46); genital segment on mid dorsal line 2.50; same including posterior processes 5.89×4.01 (1.77×1.67); posterior process 3.39 (1.07); abdomen 2.84 (1.20); anal lamina 1.60 (1.20).

Scombroid host: *Acanthocybium solandri* (Cuvier and Valenciennes)

Locality: Cocos Island, E. Pacific.

Non-scombroid hosts: ?

Location: External surface of body.

Remarks: Shiino's (1960) redescription represents the first record of this species from the Pacific. Stebbing (1900) was the first to describe the male of this species (See Wilson, 1905, p. 702).

Gloiopotes longicaudatus (Marukawa, 1925)

(Figures 25 : 1-14, and 26 : 1-2)

(Syn. *Caligus longicaudatus* Marukawa, 1925; *Gloiopotes* sp. Yamaguti, 1936; *Gloiopotes zeugopteri* Rao, 1951)

Material examined: Several specimens, both males and females collected from the sailfish *Istiophorus gladius* and the blue marlin *Makaira nigricans* at Tuticorin, Gulf of Mannar, during July 1960, and June-October 1961.

Our material agrees with the description of *Gloiopotes zeugopteri* Rao which species has been synonymised with *G. longicaudatus* by Shiino (1954).

Description: Female.—Carapace as long as wide, less than half total length; shape of carapace more or less circular; dorsal plates on fourth segment kidney-shaped overlapping genital segment scarcely on anterior part; genital segment mid-dorsally twice as wide as long, but length with posterior process (excluding lateral process) equals width; postero-lateral processes of genital segment long, conical, extending to level of hind margin of abdomen; first abdominal segment about half as long as second; anal laminae slightly shorter than second abdominal segment; spinular arrangement on posterior part of body as shown in figure 26 : 1-2. Appendages as shown in figure 25 for *G. zeugopteri*. Egg strings about one-third total length.

Male.—Carapace as in female; dorsal plates of fourth thoracic segment lobular, hardly overlapping genital segment; genital segment as in male of *G. ornatus*, but posterior styliform processes reach to level of middle of second abdominal segment; antennae with an accessory claw on outer margin.

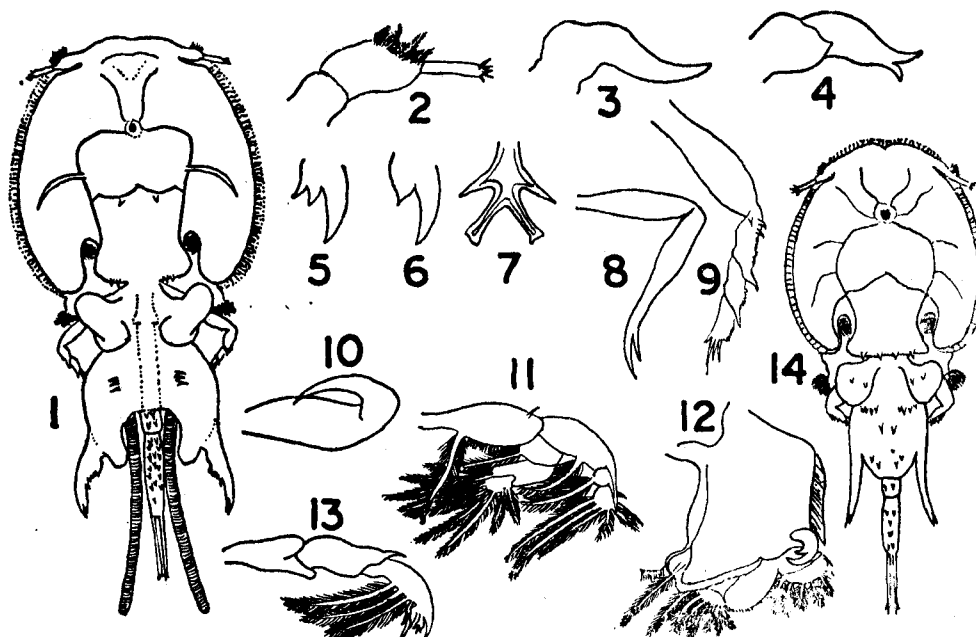


FIG. 25. *Gloiopotes zeugopteri* Rao (= *G. longicaudatus* (Marukawa)). *Female*. (1) dorsal view; (2) antennule; (3) antenna; (4) antenna (*Male*); (5) maxillule; (6) maxilla; (7) sternal furca; (8) first maxilliped; (9) fourth leg; (10) second maxilliped; (11) second leg; (12) third leg; (13) first leg; *Male*. (14) dorsal view (after Rao).

- Scombroid host* :
1. *Makaira mazara* [= *Makaira nigricans* (Lacepede)].
 2. *Makaira marlina* [= *Makaira indica* (Cuvier)].
 3. *Makaira mitsukurii* [= *Makaira audax* (Philippi)].
 4. *Makaira nigricans* (Lacepede).
 5. *Istiophorus gladius* (Broussonnet).
 6. *Xiphias zeugopteri* [= ? *Makaira* sp.].

Localities : 1. Indian Ocean (2°11' S, 82° 58' E.) ; 2. Indian Ocean (7° 10' S, 75° 20' E.) ; 3. Indian Ocean ; 4 and 5. Tuticorin, Gulf of Mannar, India ; 6. Lawson's Bay, Waltair, Andhra Coast, India (Bay of Bengal).

Non-scombroid host : *Galeus glaucus* (Loc. ?)

Locations : On surface of body ; also inside gill cover.

Remarks : As mentioned in the introduction to this paper, the host record for item six in the scombroid host list given above appears to be wrong. We are unable to find any reference to a 'swordfish' by the name of *Xiphias zeugopteri* in ichthyological literature and feel that Rao could have obtained his material from a species of marlin (*Makaira* sp.)

There appears to be considerable similarities between *G. longicaudatus* as described here and *Gloiopotes watsoni* Kirtisinghe (1933). Rao (1951) separated *G. zeugopteri* (= *G. longicaudatus*) from *G. watsoni*, principally on the following four characters :

1. The shape of the dorsal plates which are longer than broad,
2. the posterior claws of the first legs being trifurcate,
3. the outer ramus of the third leg being armed with bifid claw, and
4. the anal laminae not bearing any plumose setae.

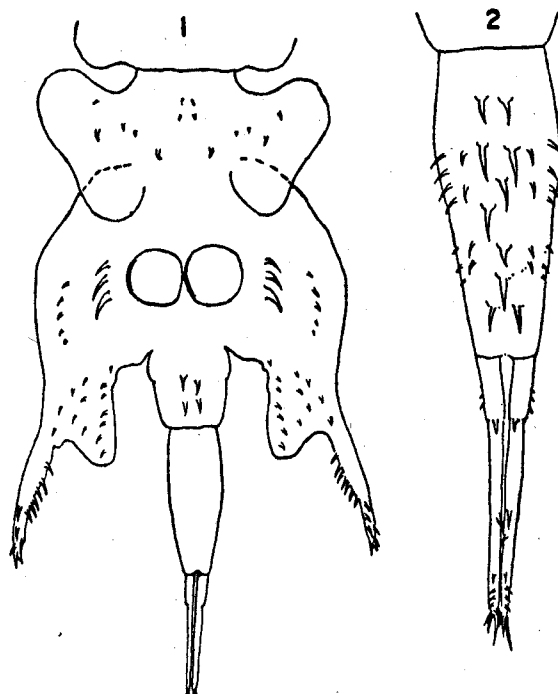


FIG. 26. *Gloiopotes longicaudatus* (Marukawa). Female. (1) and (2) fourth thoracic segment, genital segment, abdomen, and anal laminae, showing nature and disposition of spines (material from Gulf of Mannar).

The significance of the first and last characters in specific distinction is dubious. The second and third characters are as for the genus, but *G. watsoni* is said to differ as follows :

Posterior claws of the first legs are bifurcate ; outer ramus of third leg armed with a three-pronged claw.

We have not examined specimens nor the original description of *G. watsoni*. However, an accommodation of a species with the last mentioned two characters will involve a redefinition of the genus.

For further remarks see 'Addendum'.

Gloiopotes watsoni Kirtisinghe, 1933

Scombroid host : 'Sailfish' [= *Istiophorus gladius* (Broussonnet)].

Locality : Off Ceylon.

Non-scombroid hosts : None.

Location : External surface of body.

Remarks : See under *G. longicaudatus* (Marukawa) and also 'Addendum'.

Family : CECROPIDAE

Genus *Cecrops* Leach, 1816

Female.—Carapace oval, robust, distinctly notched in front and deeply excavated posteriorly ; frontal plates fused with carapace ; third thoracic segment with small fused dorsal plates ; fourth thoracic segment with larger fused plates ; genital segment with fused dorsal plates larger than carapace ; abdomen with expanded ventral plates, but small ; caudal laminae short ; abdomen and caudal rami concealed by overlapping plates of genital segment ; antennule small, two jointed ; antenna moderately stout, terminating in a strong hook ; other cephalic appendages as in Caligidae ; all four pairs of thoracic legs biramous ; rami of first three pairs two-jointed and those of fourth pair with a single joint.

Male.—Smaller, similar to female except dorsal plate of genital segment relatively smaller, exposing part of abdomen ; and fourth pair of legs not much enlarged.

Cecrops latreilli Leach, 1816

(Figure 27 : 1-2)

Description : *Female*.—As given for genus. Ovisacs numerous, irregularly coiled, concealed, eggs uniserially arranged.

Male.—As given for genus. Dorsal plates and margins of carapace smooth as in female.

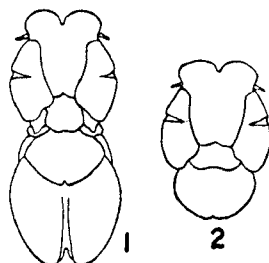


FIG. 27. *Cecrops latreilli* Leach. (1) dorsal view of female; (2) dorsal view of male (after Scott and Scott).

Scombroid host : *Thynnus* [= *Thunnus* (*Thunnus*) sp.].

Locality : Atlantic.

Non-scombroid hosts : *Mola mola* (Atlantic, Mediterranean and Pacific) ; *Scophthalmus maximus*, *S. rhombus* (See Brian, 1912) ; *Diodon*, *Pleuronectes* (See Barnard 1955).

Location : On surface of body.

References : Leach (1816) ; Baird (1850) ; Hoeven (1857) ; Scott, A. (1892) ; Bassett-Smith (1899) ; Scott, T. (1900) ; Wilson (1907, 1932) ; Elwes (1909) ; Verrill and Smith (1873) ; Rathbun R. (1884) ; Rathbun, M. J. (1905) ; Sumner *et al.* (1913) ; Stebbing (1910) ; Brian (1912) ; Thomp-

son (1899) ; Shishido (1898) ; Yamaguti (1936) ; Scott and Scott (1913) ; Barnard (1955) ; Ronald (1959) ; and Shiino (1959b).

Remarks : This species is fairly large in size, the female attaining about 25 mm. and the male 16 mm., and is reported to breed from May to October. The record from the scombroid host is by Heegaard (1943) who found a specimen on *Thynnus*, but suggests that the said host record may be due to a mistake in labelling or accidental transference from the parasite's normal host.

Family : ANTHOSOMIDAE

Genus *Lernanthropus* Blainville, 1822

Female.—Head and first thoracic segment fused into carapace, with lateral margins curved down ventrally ; second to fourth segments fused, covered by a single dorsal plate, prolonged backwards over genital segment and abdomen ; latter one or two-segmented ; antennule filiform, joints more or less fused ; antenna and maxilliped prehensile, uncinata ; first and second pairs of legs rudimentary, biramous ; rami of third and fourth pairs of legs modified ; each leg of third pair formed of fused inner and outer ramus, folded along middle and fleshy ; rami of fourth legs elongated, extending backwards, fleshy ; ovisacs elongate, filiform, eggs uniseriate.

Male.—Carapace with flat margin ; second to fourth segments fused with genital segment ; no dorsal plates ; abdomen single segmented, visible dorsally ; first, second and third legs as in female ; rami of fourth legs fused, elongate, projecting backwards.

Lernanthropus hiatus Pearse, 1951

(Figure 28 : 1-3)

Description : *Female*.—Unknown.

Male.—Minute (1.7 mm.) ; cephalothorax half as long as rest of body ; anal laminae not reaching as far back as endopod of fourth leg and armed above with small setae near their bases and tipped with three small setae ; antennule six-segmented ; antenna stout, terminal hook bearing two small spines ; preceding segment with one short spine ; mouth-tube slender, triangular ; maxillule with two stout terminal setae, one of which is three times length of other, maxillule separated from antenna by wide space (0.25 mm.) ; maxilla about two-thirds as long as maxilliped ; hooks of both smooth ; first leg with basipod with several acute spines, one-segmented exopod bearing five terminal spines and endopod bearing long terminal setae ; second leg with endopod terminating in sucker armed with large and small spines ; endopod with one terminal seta ; no segmentation evident in posterior half of body ; third leg with endopod less than one-third length of exopod ; endopod of fourth leg less than half that of exopod.

Scombroid host : *Germo alalunga* [= *Thunnus* (*Thunnus*) *alalunga* (Bonnaterre)].

Locality : Bimini, Bahamas, Atlantic.

Non-scombroid hosts : None.

Location : Gills.

Remarks : The wide gap between antenna and maxillule, the arrangement of spines of antenna, and the arrangement of setae on anal laminae are said to aid in distinguishing this male from the descriptions of known males of other species of the genus. See also 'Addendum' for a recent addition to this genus.

Family : DICHELESTHIIDAE

Genus *Hatschekia* Poche, 1902

Female.—Head distinct, first three thoracic segments free or fused with each other ; rest of thorax fused with genital segment into an elongated trunk ; abdomen when present short and

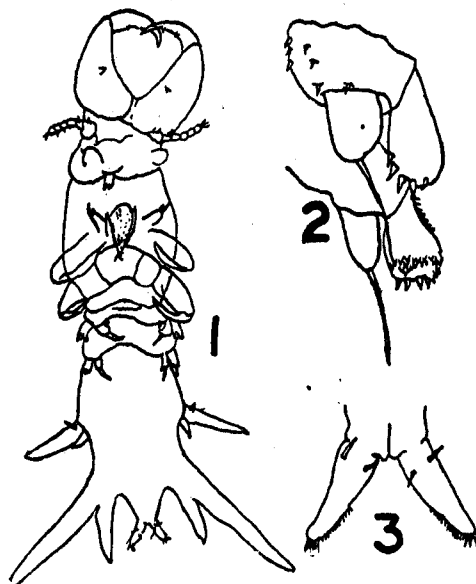


FIG. 28. *Lernanthropus hiatus* Pearse. Male.
(1) ventral view ; (2) first and second legs ; (3) caudal laminae (after Pearse).

one-segmented ; anal laminae minute ; antennule filiform, three to six-segmented ; antennae with stout apical claws ; maxillipeds slender and uncinata ; two pairs of biramous swimming legs and sometimes rudiments of third and even fourth ; fifth legs wanting ; egg strings short ; eggs large.

Male.—Head as in female ; thorax fused with genital segment into spindle-shaped trunk often with indications of segmentation ; more or less distinct, one-segmented abdomen present ; anal laminae large, armed with spines ; other appendages as in female.

***Hatschekia mulli* (van Beneden, 1851)**

(Figure 34 : 1-12)

(Syn. *Clavella mulli* van Beneden, 1851).

Description : Female.—Body elongate, cylindrical, head small, wider than long ; rest of body indistinctly segmented ; a small rounded projection on antero-dorsal aspect of body behind head ; width of body (genital segment) about one-fourth total length ; posterior end of genital segment trilobed, lateral lobes small and distinct ; middle one broad, but not prominent ; antennule short, three-segmented ; third and fourth legs absent ; other appendages as figured.

Male.—Unknown.

Scombroid host : *Scomberomorus cavalla* (Cuvier).

Locality : Grand Isle, Louisiana, U.S.A. (Atlantic).

Non-scombroid host : *Mullus barbatus* (Plymouth, Cornwall—British Seas).

Location : Gills.

References : van Beneden (1851) ; Bassett-Smith (1896) ; Norman and Scott (1906) ; Scott and Scott (1913) ; Causey (1953a).

Remarks : Causey (1953a) recorded this species from the above scombroid host and thus while extending its distribution to the American waters, remarks that 'I feel somewhat uncertain about this determination.'

Family : PSEUDOCYCNIDAE

Genus *Pseudocycnus* Heller, 1865

(Syn. *Cybicola* Bassett-Smith, 1898).

Female.—Head fused with first thoracic segment ; second and third segments free ; fourth and fifth segments fused with genital segment into a cylindrical body several times longer than wide and of uniform diameter throughout its length ; abdomen one-segmented, narrower than genital segment ; caudal laminae of varying length and width ; egg strings filiform, longer than broad, eggs minute ; numerous and strongly flattened ; antennule of several segments, with a tuft of setae at tip ; antenna stout, prehensile, armed with a strong claw, mouth tube short ; maxillae uncinata and setiferous ; maxillipeds large with toothed terminal claw ; first thoracic legs reduced, uniramous, one-segmented, unarmed and may in some cases be absent ; second legs biramous, rami one-segmented and setiferous ; third and fourth legs uniramous with terminal setae ; fifth legs obsolete.

Male.—Head fused with thoracic segment which is narrowed into a short neck connecting second segment ; second thoracic segment free or only partly free ; second, third and fourth segments of about same width ; fifth and genital segment fused forming trunk and of same width as preceding segments ; abdomen one-segmented, abruptly narrowed ; anal laminae foliate, armed with spines ; antennae and mouth parts as in female ; first, third and fourth legs uniramous and one-segmented ; fourth pair cylindrical, extending laterally ; second legs biramous, rami one-segmented.

Remarks : For discussion also refer 'Addendum'.

Pseudocycnus appendiculatus Heller, 1865

(Figure 29 : 1-5)

(Syn. *Pseudocycnus thynnus* Brandes, 1955).

Material examined : Two specimens, females (one damaged) were obtained by us from the gills of the northern bluefin tuna, *Kishinoella tonggol* (Bleeker) caught at Mangalore, on the west coast of India.

Recent records of this species, mainly from scombroid fishes from various parts of the world indicate its very wide distribution in the Indo-Pacific, Atlantic and Mediterranean. The present record would appear to represent the first record of this species from the Indian coast from a new host species.

Description : *Female*.—Carapace ovate, slightly broader than trunk ; posterior margins prolonged into wide rounded lobes above level of maxillipeds ; first segment seen dorsally as narrow neck between lobes of carapace, less than one-fourth width of latter, and ventrally carrying first legs ; second, third and fourth segments globular, increasing gradually in size, fourth

being slightly the larger; only slight constrictions between segments; along antero-dorsal border of each of these three segments, on either side, a latero-dorsal lamina in the form of a thick margin (rudimentary dorsal plates as given by Wilson, 1932) present, the ones on fourth segment digitiform; fourth and fifth segments fused with genital segment; abdomen half as wide as trunk, single-segmented carrying anus on dorsal side; caudal laminae lanceolate, acutely pointed, divergent and about one-third total length; antennule four-segmented, one spine-like seta on outer terminal end of second segment from base; terminal segment longer than penultimate and carrying two or three stumpy setae; antenna of a stout basal segment and a strong terminal claw bearing dentate projections on inner surface; mandibles styliform apparently toothless; maxillules filiform, three-segmented, segments bent upon themselves; terminal segment bifurcate; maxillae three-segmented; basal segment enlarged, middle segment slender, with anterior margins crenulate and provided with a row of stout spines; terminal segment short, curved, claw-like; maxillipeds stout, powerful, prehensile organ, two-segmented; terminal segment with undulating margin giving dentate appearance, with a sharp spine on inner margin being capable of flexion against basal joint; latter with a toothed projection on inner margin at about midlength; first legs reduced into small flattened plates without setae and situated immediately inside basal joints of maxillipeds; second and third legs as for genus; fourth legs minute, four-jointed, each leg projects from lateral margin immediately behind dorsal laminae of fourth segment; egg strings slender, cylindrical and greatly elongate being much longer than total length.

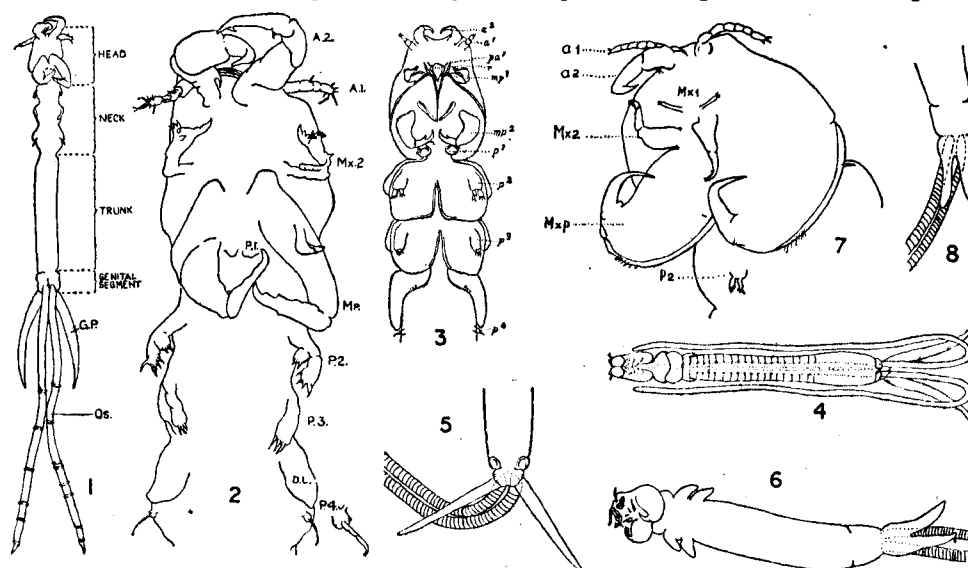


FIG. 29. *Pseudocycnus appendiculatus* Heller. 1-5. Female. (1) ventral view; (2) and (3) ventral view of cephalothorax showing appendages; (4) dorsal view; (5) posterior end of body enlarged, showing anal laminae; *Pseudocycnus armatus* Bassett-Smith. 6-8. Female. (6) ventral view; (7) ventral view, anterior part of cephalothorax showing appendages (only right antenna shown); (8) posterior end of body showing abdomen and anal laminae (Figures 1-2 after Leigh-Sharpe; figures 3-4 after Heller; figures 5-8 from actual material examined. Figures 5 and 8 are drawn to same scale).

Male.—Carapace ovate, nearly as wide as long, with a small rostrum; behind head and more or less fused with it the first segment forms a narrow short neck; second segment wider and at least four times as long as first; third segment wider than second, but shorter; fourth segment still wider and longer; fourth legs extending as cylinders from lateral margin; fifth and genital segments fused, as wide as fourth segment, with a small spine at centre of each lateral margin; abdomen one segmented, longer than wide, enlarged posteriorly; caudal laminae longer than abdomen, divergent, bluntly rounded, each with an apical fringe of minute spines; appendages similar to those of female. Total length 3.5 mm.

- Scombroid hosts* : 1. *Oreynus alalunga* [= *Thunnus (Thunnus) alalunga* (Bonnaterre)]
 2. *Sarda chilensis* (Cuvier and Valenciennes)
 3. *Euthynnus yaito* [= *Euthynnus affinis yaito* (Kishinouye)]
 4. *Neothunnus macropterus* [= *Thunnus (Thunnus) albacares macropterus* (Temminck and Schlegel)]
 5. *Euthynnus alletteratus* (Rafinesque)
 6. *Thunnus thynnus* [= *Thunnus (Thunnus) thynnus thynnus* (Linnaeus)]
 7. *Sarda sarda* (Bloch)
 8. *Kishinoella tonggol* (Bleeker)

Localities : 1. South of Marthas Vineyard, New England Coast, U.S.A.; 2. Acapulco, Guerrero, Mexico (Pacific); 3. North of Missol, New Guinea (Pacific); 4. 18°24' N., 104°38' W.; 5, 6 and 7. See Shiino 1959e; 8. present record from Mangalore, West Coast of India.

Non-scombroid hosts : *Coryphaena* sp. (Atlantic).

Location : Gills.

References : Heller (1865); Bassett-Smith (1898); Brian (1902, 1906, 1908, 1912); Wilson (1922, 1932); Leigh-Sharpe (1930); Kirtisinghe, (1935); Klinberg (1942); Carvalho (1951); Brandes (1955); Pearse (1956 ?); Shiino (1959e); Richiardi (1880); Carus (1885); Stebbing (1900); Causey (1960).

Remarks : There appears to be notable differences in the total lengths of mature females described by various authors. Wilson gives 12-16 mm. (total length including caudal laminae) for Atlantic specimens, while Leigh-Sharpe gives 13.2 mm., and Shiino 13.0 to 14.3 mm. The single undamaged specimen in our collection measures only 10.6 mm. It is quite likely, the differences in the length of this parasite species may be due to differences in the lengths of the gill filaments in the different host species, because *P. appendiculatus* is found to lie closely adpressed to the gill filaments. In fact, Leigh-Sharpe (1930) mentions that 'The entire head was buried in a spherical cyst from which it had to be dissected out . . .'

The differences in proportionate measurements for specimens from various localities in the Indo-Pacific may be made out from data given in Table 2.

TABLE 2

Measurements (in mm.) of *Pseudocycnus appendiculatus* Heller from various localities from the Indo-Pacific.

Characters	Shiino, 1959e 6°30' N., 77°53' W.	Shiino, 1959b			Leigh- Sharpe (1930)	Present record from W. Coast, India
		81°00' E. 11°45' N.	77°20' E., Spec. No. 1	5°40' S., Spec. No. 2		
Total length (excluding anal laminae)	9.73	8.7	11.6	9.3	10.8	8.0
Carapace length × width	1.10 × 1.07	1.2 × 1.2	1.4 × 1.3	1.2 × 1.0	1.3 × —	—
First thoracic segment : L × W	0.10 × 0.53	0.8 × 1.2	0.6 × 1.3	0.7 × 1.6	1.7 × —	0.5 × —
Second thoracic segment : L × W	0.73 × 1.09					
Third thoracic segment : L × W	0.60 × 1.20					
Rest of body : L × W	7.40 × 1.33	6.5 × 1.4	11.1* × 1.5	6.5 × 1.1	..	5.5 × 1.2
Genital segment	..	..	..	..	0.3	..
Anal lamina	3.73	4.3	5.4	3.3	2.4	2.6
Length of egg string	24.8	..	..	..	6.6	10.5

* Shiino's figure of '11.1' is an error, and should be 9.1 as can be deduced from other measurements given by him for the same specimen.

***Pseudocycnus armatus* (Bassett-Smith, 1898)**

(Figure 29: 6-8; and 15: 1-11)

(Syn. *Helleria armata* Bassett-Smith, 1898 - genus *Helleria* Bassett-Smith is preoccupied and hence changed to *Cybicola* by Bassett-Smith, 1898).

Material examined: Our collection contains several female specimens obtained from the seerfish, *Scomberomorus commerson* (Lacépède) from the Andaman Sea.

Description: Female.—Head rounded, shallow central sulcus between antennules; first three thoracic segments fairly distinct, devoid of carapace; laterally thoracic segments produced into lobes, which in second and third segments are blunt and digitiform, a very conspicuous feature of this species; fourth, fifth and genital segments fused into trunk; abdomen short, less than width of trunk and indistinctly separated from latter; anal laminae foliate, of each side fused in basal one third and confluent with abdomen; length much greater than width of trunk and about 3.5 in total length; egg strings greatly elongate, about as long as total length, eggs minute, numerous and greatly flattened; antennule six jointed; antenna three jointed, strongly hooked at end; second maxillipeds very large, basal joint robust; thoracic appendages as for genus.

Measurements (mm.): For one egg-bearing female in the collection: Total length excluding anal laminae 6.8; length of anal laminae 1.0; length of head 1.1; second thoracic segment 0.5; third thoracic segment 0.32; length of egg string 7.0.

Male.—Elongate, head rounded, fused with first thoracic segment to form cephalothorax, latter narrowed posteriorly; antennule six jointed, directed laterally; antenna projecting anteriorly; maxillae visible outside lateral margins of cephalothorax; maxillipeds as large lateral lobes below posterior region of cephalothorax and second thoracic segment; latter incompletely fused with first and third segments; and about two-thirds as wide as head; third segment fused with fourth and subsequent segments to form elongate cylindrical trunk; abdomen one segmented, narrower than genital segment; anal laminae foliate, slightly longer than abdomen; antennule seven segmented, terminal segment setose; antenna three segmented forming strong prehensile organ; terminal claw strongly curved and sharply pointed with a small spine on its inner margin; mouth tube pear-shaped; maxillule two segmented; basal segment long, terminal segment much shorter, bifid at tip; maxilla two segmented; basal segment cylindrical, terminal longer and ending in a claw, concavity of which is covered with numerous minute setae; maxilliped large, two segmented; second segment ending in a strong curved claw, which carries a minute spine at its inner border; appendage of first thoracic segment modified to form a pair of elongate styles arising from flattened bases; second legs biramous, with a basal segment and one segmented rami; former with a large seta on its outer margin; rami of about equal size; endopodite tipped with a long jointed seta and two smaller setae, exopodite with three setae, outermost of which is largest; third legs uniramous, one segmented, tipped with two or three setae; fourth legs represented by a seta arising from a short stumpy base on lateral margin of segment.

Measurements (mm.): Male.—Total length 2.6; cephalothorax 0.6; thorax and trunk 1.6; abdomen and anal laminae 0.4 (after Kirtisinghe).

- Scombroid hosts:**
1. *Cybium guttatum* [= *Scomberomorus guttatus guttatus* (Bloch and Schneider)]
 2. *Cybium commersoni* [= *Scomberomorus commerson* (Lacépède)]
 3. *Scomberomorus commerson* (Lacépède)

Localities: 1-3. Bombay coast, India; Ceylon coast; Andaman Islands, Andaman Sea (Bay of Bengal) respectively.

Non-scombroid hosts : None.

Location : Gills.

References : Bassett-Smith (1898) ; Kirtisinghe (1935, 1937). For additional recent records reference may be made to the section "Addendum".

***Pseudocycnus buccatus* Wilson, 1922**

Description : Female.—Carapace ovate, considerably wide anteriorly and narrow posteriorly where it is divided into two lobes by a narrow median sinus ; second segment not as wide as head ; narrowed anteriorly widest across posterior margin ; third segment wider and shorter than second ; subsequent segments fused into trunk which is five times as long as wide ; egg strings relatively broader, being one third as wide as trunk, and as long as it ; abdomen half width of trunk ; one segmented caudal laminae short and conical, each tipped with single seta ; antennule indistinctly three segmented ; terminal claw of antenna with an accessory spine on its inner margin near centre ; and maxilliped greatly enlarged, terminal claw long and slender ; first legs mere knobs ; each second leg a bilobed lamina appearing as two rami ; third leg a short and wide lamina ; fourth leg obsolete. Total length 4.0-5.0 mm.

Male.—Unknown.

Scombroid hosts : 1. *Scomberomorus cavalla* (Cuvier)
2. *Scomberomorus maculatus* (Mitchill)
3. *Scomberomorus regalis* (Bloch)
4. *Scomberomorus maculatus* (Mitchill)
5. *Scomberomorus sierra* [= *Scomberomorus maculatus* (Mitchell)]

Localities : 1 & 2. Woods Hole and Marthas Vineyard, U.S.A. (N.W. Atlantic) and Texas Coast, U.S.A. ; 1. also from Veracruz, Gulf of Mexico ; 3 & 4. Veracruz and Anton Lizardo near Veracruz, Gulf of Mexico respectively ; 5. Cholla Bay near Puerto Penasco, Sonora, Mexico.

Non-scombroid hosts : *Paralabrax maculatofasciatus* (Cholla Bay, near Puerto Penasco, Sonora, Mexico).

Locations : Gills and demibranchs.

References : Wilson (1922, 1932) ; Causey (1960).

Remarks : Wilson (1922) mentioned that in *P. buccatus* the antennule is six segmented, an error subsequently corrected by him in 1932 to read "... first antenna indistinctly 3-segmented." Causey (1960) remarks that the Pacific forms of this species may be slightly smaller than the Gulf of Mexico representatives.

***Pseudocycnus elongatus* (Pearse, 1951)**

(Figure 30 : 1-5)

(Syn. *Cybicola elongata* Pearse, 1951)

Description : Female.—Body elongate, more than 9 times as long as wide ; segmentation indistinct ; head slightly wider than body with a small median sinus in front, rounded behind ; head slightly more than 7 times in total length (excluding anal laminae) ; thorax with lateral constrictions that separate first two segments, and swellings that indicate third ; genital segment and abdomen not distinctly demarcated ; caudal laminae shorter than abdomen, tips bearing

one long and two short setae ; antennule seven segmented, a seta on basal segment and at least three on tip ; antenna small, three segmented, terminal hook with a spine on inner margin ; mouth tube slender and conical ; maxillule with a small terminal hook and two strong setae ; maxilla small, slender with curved terminal hook ; maxillipeds enormous, covering most of ventral side of head, with lamellate outer margin on penultimate segment except where terminal hook

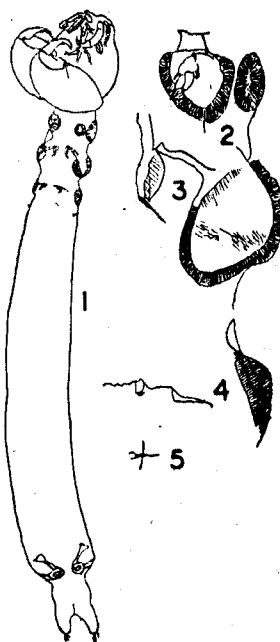


FIG. 30. *Pseudocycnus elongatus* Pearse. Female. (1) ventral view ; (2). first legs ; (3) second legs ; (4) third legs ; (5) fourth legs (after Pearse).

meets it where it is smooth, but further proximal it is setose ; a stout short spine at medial base of terminal hook which is sharply curved ; first leg surrounded by, and first three legs associated with, lateral, finely papillose areas ; first leg biramous, with a spine at base and a spine at either side of distal margin of basal segment ; exopod one segmented, with four minute spines at tip ; endopod uniramous with a seta at tip ; papillose area with a seta at posterior margin of disc that surrounds appendage ; another elliptical papillose area on lateral margin near first leg ; second leg uniramous, flat, rounded at tip, with a row of striations on lateral surface ; papillose area lateral to it, oval and larger than that of first leg ; third leg very small, single segment with a small curved terminal hook ; fourth leg represented by a seta that arises from a papilla. Total length 5.3 mm. ; head 0.7 mm.

Male.—Unknown.

Scombroid host : *Scomberomorus maculatus* (Mitchill)

Locality : Bimini, Bahamas, Atlantic.

Non-scombroid hosts : None.

Location : Gills.

***Pseudocycnus spinosus* Pearse, 1952**

Scombroid host : *Scomberomorus* spp.

Locality : Texas Coast, U.S.A. (Atlantic).

Non-scombroid host : *Cynoscyon nebulosus* (Texas Coast, U.S.A., Atlantic).

Location : Gills.

Family : LERNAEIDAE**Genus *Lernaeenicus* LeSueur, 1824**

Female.—Head and thorax fused, former furnished with 2 to 10 slender cylindrical horns which are simple or branched; thorax just behind head enlarged and furnished with four pairs of legs close together; behind legs thorax filiform and chitinous, twisted, and usually flexed for half length of body or more from whence it enlarges into straight cylindrical trunk eventually narrowing into an abdomen; caudal laminae minute or lacking; egg strings filiform and very long; antennules present; antennae chelate; mandibles without teeth; only one pair of maxilla; maxillipeds absent; first two pairs of legs biramous, third and fourth pairs uniramous; fifth pair wanting.

***Lernaeenicus longiventris* Wilson, 1917**

Description : Female.—Head at right angles to neck, without horns, but with 3 knobs, one posterior and two lateral; neck much longer than trunk and becoming narrower backwards; trunk cylindrical, portion representing genital segment one fourth as long as neck, and four times as long as wide; portion representing abdomen filiform, half as long as neck, about thirty times as long as wide; legs as for genus, rami two segmented; and armed with plumose setae. Total length 40-50 mm.; length of egg strings 10-15 mm.

Scombroid host : *Scomberomorus maculatus* (Mitchill).

Locality : Woods Hole, Massachusetts, U.S.A. (Atlantic).

Non-scombroid hosts : *Palinurichthys perciformis*, *Pomatomus saltatrix*, *Caranx hippos*, *Caranx chrysos* (Woods Hole, Massachusetts, U.S.A. N.W. Atlantic); *Coryphaena hippurus* (Atlantic S.E. of Nantucket, U.S.A.); *Pogonias chromis* (Norfolk, Virginia, U.S.A.); *Mugil cephalus* (Beaufort, North Carolina, U.S.A.); *Seriola dorsalis* (Mazatlan, Sinaloa, Gulf of Mexico); *Caranx hippos* and *Rachycentron canadus* (Texas Coast, U.S.A.—Causey 1953); *Caranx chrysos*, *Coryphaena hippurus* and *Phycis floridanus* (Grand Isle, Louisiana, U.S.A.—Causey, 1953).

Locations : From sides of body of host; also observed on gills and operculum.

References : Wilson (1917, 1932); Causey (1960).

Remarks : Wilson (1932) remarks that the head of this parasite is buried close to the backbone of its host and is surrounded with a fibrous tough membrane. Generally only a single specimen is found on a host individual.

***Lernaeenicus seeri* Kirtisinghe, 1934**

Scombroid host : Seerfish, *Cybium* sp. [= *Scomberomorus* sp.]

Locality : Ceylon coast.

Non-scombroid hosts : None.

Location : Sides of body of host.

Lernaeenicus sp. Rao, 1951

Scombroid host : *Scomber scomber* [=? *Rastralliger kanagurta* (Cuvier)]

Locality : Lawson's Bay, Waltair, Andhra coast, India (Bay of Bengal).

Non-scombroid hosts : None.

Location : On body.

Remarks : Host record is wrong as the true *Scomber scomber* (= *Scomber scombrus*) is thus far known from the Atlantic and Mediterranean. It is quite likely that the specimen was observed on the Indian mackerel *Rastralliger kanagurta* by Rao (1951). No description of the parasite is given.

Family : PENNELLIDAE

Genus **Pennella** Oken, 1816

(Syn. *Baculus* Lubbock, 1860 ; *Hessella* Brady, 1883—both representing young female).

Female (adult).—Head more or less globular, fused with first segment, with two or three horns or processes for attachment ; anteriorly head truncate, trunk elongate, straight, transversely ridged ; abdomen short, annulated carrying plumose appendages laterally ; a pair of minute caudal laminae carrying long setae ; egg strings filiform, several times length of body ; antennule with few segments ; antenna chelate ; mouth parts obsolete ; first and second pairs of legs biramous, situated close together ; third and fourth pairs uniramous, all rami two jointed, setose.

Copepodid male.—Head fused with first segment ; second third and fourth segments free and diminishing in width ; fifth and genital segments fused ; abdomen one segmented, caudal rami wide, setose ; antennule indistinctly jointed ; antenna two jointed with stout chela ; mandibles, two pairs of maxillae, and a pair of maxillipeds well developed ; legs as in female ; fifth pair absent.

Adult females are parasitic on fishes and marine mammals.

Pennella biloba Kirtisinghe, 1933

(Figure 31 : 6-8)

Description : Female.—Head twice as broad, marked dorsally by two grooves which divide it into a median triangular area and two lateral lobes, base of triangular area merging with neck ; two types of papillae present on heart-shaped ventrally inclined anterior end of head—large irregularly arranged papillae seen along border while smaller papillae present on either side of mouth ; a pair of lateral horns lying at right angles to head ; horns of uniform diameter, bluntly rounded distally ; neck separated from genital segment by slight constriction ; genital segment broader than neck, tapering gently towards its posterior end ; neck and genital segment of same length ; transverse ridges absent on genital segment and abdomen ; appendages ill-developed ; antennule not traceable ; antenna a pair of short three jointed processes on dorsal side of head at apex of triangular area ; legs greatly reduced, retaining only their basal joints ; distance between second and third pairs of legs more than that between first and second or third and fourth pairs. Total length 32 mm. ; head 1.0 ; width of head 2.0 ; length of horn 3.0 ; neck 12.0 ; genital segment 12 ; abdomen 7 ; egg strings 16.

Scombroid host : *Histiophorus brevirostris* Playfair [= *Makaira indica* (Cuvier)].

Locality : South West coast of Ceylon.

Non-scombroid hosts : None.

Location : Found attached close to pelvic fins of host.

***Pennella costal* Richiardi, 1880**

Scombroid host : *Xiphias gladius* Linnaeus.

Locality : Mediterranean ; probably also N.W. Atlantic (Rathbun, M. J. 1905).

Non-scombroid hosts : None.

Location : Head buried in cyst formed inside internal organs of host (Sumner *et al.* 1913).

Remarks : Heavy infestation of 30 to 40 individuals of this species in one host individual is known, appearing to impair the vitality of the fish. (Sumner *et al.* 1913).

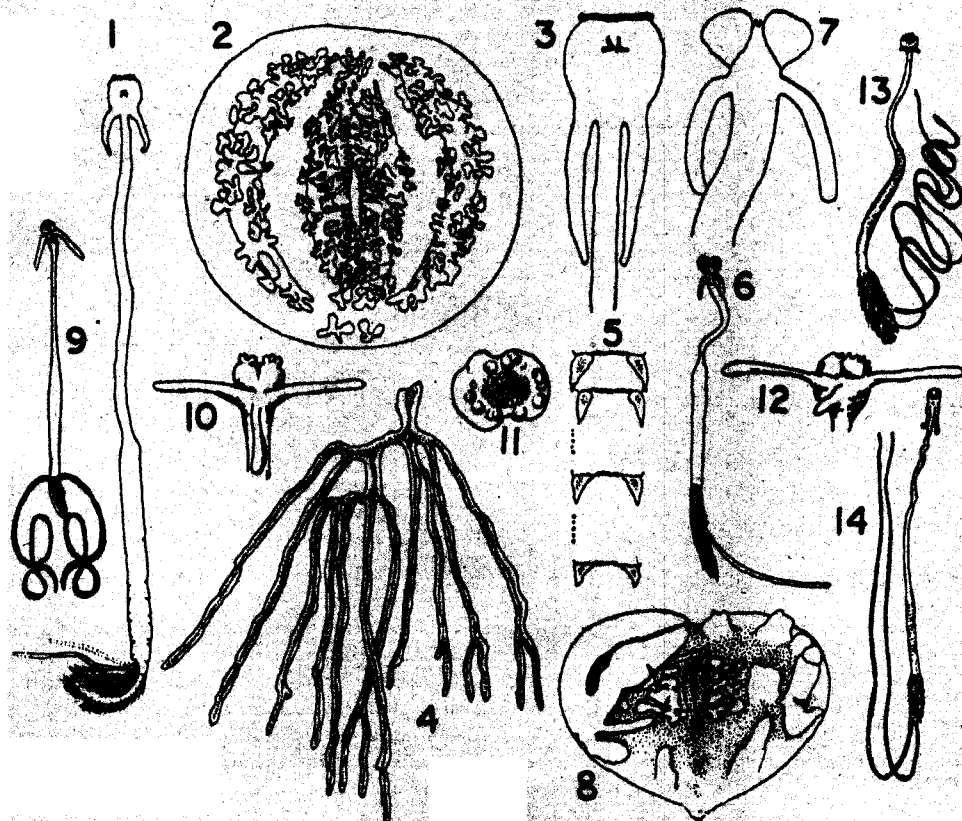


FIG. 31. *Pennella zealandica* Kirtisinghe. (= *P. instructa*) Female. (1) entire specimen ; (2) papillae of head ; (3) head and horns ; (4) abdominal appendages ; (5) thoracic legs : *P. biloba* Kirtisinghe. Female. (6) entire animal (7) dorsal view of head and horns ; (8) anterior surface of head showing papillae : *P. orthogoriscus* Wright. Female. (9) ventral view of entire animal ; *P. crassicornis* Steenstrup and Lutken. Female. (10) and (11) dorsal and slightly oblique views of head ; (12) ventral (buccal) surface of head : *P. filosa* (Linnaeus). Female (13) dorsal view of entire animal : *P. instructa* Wilson. Female. (14) dorsal view of specimen from Woods Hole area U.S.A. (after Kirtisinghe ; Barnard ; and Wilson).

***Pennella filosa* (Linnaeus, 1758)**

(Figure 31 : 13)

(Syn. *Pennatula filosa* Linnaeus, 1758)

Description : Female.—Head wider than long, papillae uniform in size and distribution, two short stout horns projecting nearly at right angles to head ; often a more or less developed median third horn between bases of aforesaid two ; neck varying in length ; trunk twice as wide as neck and transversely ridged ; abdomen about half length of trunk, plumes profusely branched ; egg strings slender, at least twice length of body.

Scombroid hosts : 1. *Xiphias gladius* Linnaeus.
2. *Istiophorus grayei* [= *Istiophorus gladius* (Broussonnet)]
3. Tunny [= *Thunnus (Thunnus)* sp.]

Localities : 1. Marthas Vineyard, U.S.A. (N.W. Atlantic) ; 2. Guaymas, Mazatlan, Acapulco, Mexico (Pacific coast of Mexico—Causey, 1960) ; 3. See Barnard, (1955).

Non-scombroid hosts : *Mola mola* (Atlantic and Mediterranean).

Location : Found partly buried on sides of body of host.

References : Linnaeus (1758) ; Guerin-Meneville (1829-43) ; Steenstrup and Lutken (1861) ; Bassett-Smith (1899) ; Scott, T. (1905) ; Norman and Scott (1906) ; Scott and Scott (1913) ; Sumner *et al.* (1913) ; Stebbing (1905-as *P. orthogorisci*) ; Brian (1908, 1912) ; Quidor (1913) ; Wilson (1917, 1932) ; Leigh-Sharpe (1928) ; Delamare—Deboutteville and Nunes-Ruivo (1954) ; Barnard (1955) ; Causey (1960).

Remarks : Causey (1960) mentions that the species is found often encrusted with the barnacle *Chonchoderma*.

***Pennella instructa* Wilson, 1917**

(Figure 31 : 1-5 and 14)

(Syn. *Pennella zeylanica* Kirtisinghe, 1932)

Description : Female.—Head longer than wide, squarely truncated anteriorly ; short papillae not covering truncated surface, but arranged in pattern ; lateral margins of head concave ; horns long, soft, bluntly pointed, extending backwards parallel to neck and lying close to it ; never more than two horns ; neck two times length and half width of trunk and generally bent and twisted ; trunk transversely ridged ; abdomen half as long as trunk ; plumes about 24 on each side and each dichotomously branched ; antennule four segmented, heavily armed with setae ; antenna two segmented ; distance separating legs are in ratio of 1:5:6. Total length 200-250 mm.

Scombroid hosts : 1. *Xiphias gladius* Linnaeus.
2. *Histiophorus gladius* Day [= *Istiophorus gladius* (Broussonnet)]

Localities : 1. Marthas Vineyard and Nantucket, U.S.A., N.W. Atlantic ; 2. South coast of Ceylon, Indian Ocean,

Non-scombroid hosts : None.

Locations : In a personal communication Dr. Kirtisinghe informs us that his *P. zeylanica* is synonymous with Wilson's *P. instructa*. Kirtisinghe (1932) found at least four specimens of *P. zeylanica* (= *P. instructa*) attached to the sides and belly of the sailfish from Ceylon. Wilson (1932) remarks that in the swordfish *X. gladius* the parasite burrows into the flesh of the host until its head is brought into contact with the fish's dorsal aorta. A tough cyst 50 mm. or more in diameter often forms round the head and neck of the parasite.

Remarks : The disjunct distribution of this species, thus in the North Western Atlantic and in the Indian Ocean near Ceylon is of considerable interest. See also 'Addendum' for recent additional records.

***Pennella crassicornis* Steenstrup and Lutken, 1861**

(Figure 31 : 10-12)

Scombroid host : *Xiphias gladius* Linnaeus.

Locality : Algerian Coast, Mediterranean (Monod, 1938).

Non-scombroid hosts : Fish : *Mola mola* (Mediterranean—Brian, 1912).

Also known from Cetacea, *Balaenoptera acutorostrata*, *Hyperoodon*. (Loc. Table Bay, South Africa and Faroes Islands respectively).

Location : Partly embedded on sides of body of host.

References : Steenstrup and Lutken (1861); Brian (1912); Monod (1938); Delamare—Deboutteville and Nunes-Ruivo (1954); and Barnard (1955).

Remarks : Although known from at least two fish hosts and two cetaceans, as Barnard (1955) has drawn attention to, there appear to be variations in this species, at least as could be noted from different descriptions. Present records indicate its occurrence only in the Mediterranean, N.E., and S.E. Atlantic.

***Pennella orthogorisci* Wright, 1870**

(Figure 31 : 9)

Scombroid host : *Germo alalonga* [= *Thunnus (Thunnus) alalonga* (Bonnaterreae)].

Locality : See Barnard (1955).

Non-scombroid hosts : *Mola mola* (North Atlantic-Europe and N.America); Table Bay, South Africa.

Location : Partly embedded in flesh of host.

References : Wright (1870); Wilson (1917, 1924, 1932); Leigh-Sharpe (1928); Stebbing (1905, 1910); Giard (1889); Scott and Scott (1913-in part); Steenstrup and Lutken (1861); Brian (1912); Barnard (1955).

Remarks : Barnard (1955) doubts whether *P. orthagorisci* could be maintained as distinct from *P. filosa* on Wilson's diagnoses of Wright's species which is characterised as having 2 (or 3) slender horns, longer than head and directed obliquely backwards; and abdomen one-third to two-fifths length of trunk.

Order : LERNAEOPODOIDA

Family : CHONDRACANTHIDAE

Genus *Chondracanthus* Delaroche, 1811

Female.—Head small, separated from thorax by clearly defined constriction; first and second segments usually free, narrower than head and posterior body; remaining segments fused with genital segment into a trunk indistinctly divided near its centre and produced at its posterior corners and ventrally or laterally into paired processes; abdomen very small, situated between lateral processes; one or two segmented; caudal laminae absent; antennule moderately large, fleshy, more or less conspicuous in front and somewhat rudimentary in structure; antenna very short, armed with strong terminal hooks to form prehensile structure; mandibles fulciform at proximal end; but tapering to more or less attenuated distal extremity; both margins with minute serrations or spines; maxillule small, provided with a straight terminal spine which is toothed on its outer margin; two pairs of biramous legs, rami rudimentary.

Male.—Minute, head fused with first segment and considerably dilated than rest of body; second segment free carrying second pair of legs; trunk four segmented; caudal laminae well developed, conical; two pairs of uniramous one segmented legs, each ramus cylindrical with two apical setae, often laminate with an anterior process.

Chondracanthus xiphae (Guerin) ? Cuvier, 1829

Scombroid host : *Xiphias gladius* Linnaeus.

Locality : Atlantic ?

Non-scombroid hosts : None.

Location : Gills.

References : See also Milne-Edward (1840); Goode (1883).

Remarks : We have not seen a description of this species, except the remarks given by Goode (1883) wherein he merely mentions that 'This species also lives on the gills of the sword-fish.'

Chondracanthus lophii Johnston, 1836

(Figure 32 : 1-7)

(Syn. *Chondracanthus gibbosus* Kroyer, 1837-38).

Description : *Female*.—Head longer than wide, with lateral projections near hind corner; thoracic segment indistinctly bisegmented into two lateral processes, hinder one shorter; genital segment constricted in middle, anterior portion with an obscurely bifid lateral process, posterior portion with two pseudolateral processes; abdomen small, dorsally concealed by a more or less

elongate process; mid-dorsally throughout length of thorax and genital segments digitiform processes present; antennule obscurely jointed, strongly expanded at base; egg strings long, curved or twisted. Total length 12.0 mm.

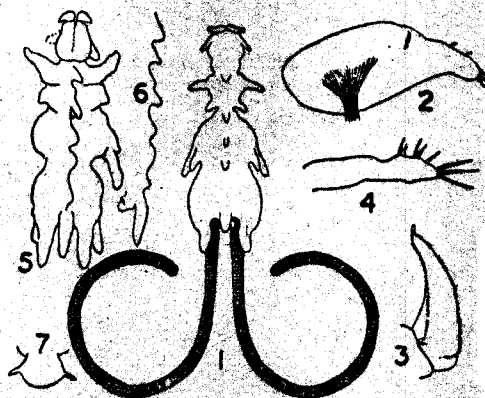


FIG. 32. *Chondracanthus lophii* Johnston. Female. (English seas) (1) dorsal view; (2) antennule; (3) mandible; (4) maxilla; (5) dorsal view of female from Agulhas Bank, S. Africa; (6) dorsal profile of same; (7) abdomen of same (Note differences in nature and disposition of lateral process between specimens from English seas and South African coast (after Scott; and Barnard).

Male.—Minute, pyriform in shape, considerably swollen anteriorly, but tapering posteriorly; provided with strongly uncinat foot-jaws.

Scombroïd host : *Thynnus* sp. [= *Thunnus* sp.]

Locality : Atlantic (see Milne-Edwards, 1840; and Pesta 1934).

Non-scombroïd host : *Lophius piscatorius* (European waters; and South Africa).

Location : In *L. piscatorius* found in gill pouch.

References : Johnston (1836); Turner and Wilson (1862); Bassett-Smith (1899); Scott and Scott (1913); Goggio (1927); Oakley (1930); Sproston (1942); Barnard (1948, 1955); Pesta (1934); Kroyer (1837-38); Rathke (1843); Thompson (1847); Baird (1850); van Beneden (1851); Vogt (1877); Scott, T. (1900); Timm (1894); Graeffe (1902); Brian (1906); Hansen (1923); Milne-Edwards (1840).

Remarks : Although the species has been very widely known from *L. piscatorius* from the Atlantic and the Mediterranean, the only reference we could find of its occurrence on a scombroïd fish is a remark made by Pesta (1934). A definite scombroïd host record for *C. lophii* appears to be wanting.

Family : LERNAEOPODIDAE

Genus *Clavellopsis* Wilson, 1915

Female.—Cephalothorax short and thick; trunk squat, often wider than long, often with posterior processes; abdomen and anal laminae wanting; an unpaired genital process present; antennule four jointed; antenna biramous, endopod one jointed, exopod two jointed; maxilla short, broad, fused, with folds of skin or swellings, with apical bulbs.

Male.—Cephalothorax and trunk at right angles, latter strongly arched dorsally, unsegmented, hind end projecting below bases of maxilla; antennule three jointed; antenna biramous, each ramus one jointed; maxillule tripartite.

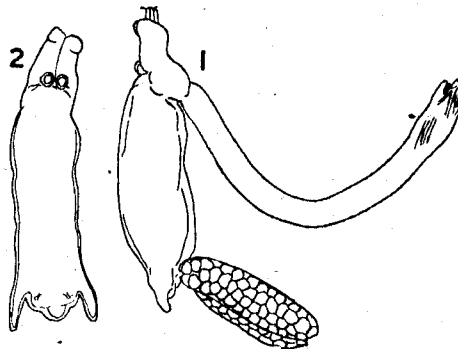


FIG. 33. *Clavellopsis saba* Yamaguti. Adult Female. (1) lateral view; (2) trunk and arm. (after Shiino).

***Clavellopsis saba* Yamaguti, 1939**

(Figure 33 : 1-2)

Scombroid host : *Scomber scomber japonicus* (= *Scomber japonicus japonicus* Houuttuyn).

Locality : Tsunodayama, Niigata Prefecture, Japan.

Non-scombroid hosts : None.

Location : Gills.

Reference : Yamaguti (1939); Shiino (1959b).

Remarks : See 'Addendum', for further notes on this and an allied specie.

Genus *Charopinus* Kroyer, 1863

Female.—Head more or less well demarcated from trunk, with or without carapace; cephalothorax elongate often flexed backwards; trunk swollen, pear-shaped, flattened dorso-ventrally with a pair of posterior processes dorsal to egg strings; genital process, abdomen and anal laminae wanting; egg strings long, cylindrical; antennules indistinctly four jointed; antenna biramous; maxilla elongate, either fused at tips into bulla of varying shape or each one apically enlarged into a chitinous bar or knob.

Male.—Anterior portion of head at right angles to posterior portion of head and thorax; carapace absent; thorax segmented; genital segment enlarged; abdomen well defined; segmented and tipped with anal laminae; antennules two, three or four jointed; maxillules tripartite palps with two setae each; maxilla and maxillipede some distance behind other mouth parts, but each, close together and separated by a groove.

The genus is distinguished from *Brachiella* Cuvier by the more elongate maxillae in female, and by the segmentation of body in the male. Generally parasitic in the nasal passages, spiracles and gills of elasmobranchs.

Charopinus quarternius Wilson, 1915

(Figure 34 : 13-20)

Description : Female.—Head with carapace covering entire dorsal surface and part of lateral sides ; neck well defined with indistinct transverse grooves ; two pairs of posterior processes, one median and one lateral, very unequal in length and both pairs ventral to egg strings ; median pair flattened dorso-ventrally and pointed, their bases fused along mid-ventral line and $5/7$ th as long as trunk ; lateral pairs also flattened ; laminae triangular in shape, one at each posterior corner, one-fourth as long as median pair ; egg strings attached between median and lateral processes and dorsal to both, and equalling total length ; appendages as shown in figure ; however, maxilla removed to some distance behind maxilliped, entirely separate, except a slight adhesion at inner surfaces of two bullas which are in contact and slightly fused ; maxillipeds close behind mouth tube with a long and stout basal segment which is grooved on its inner surface distally for reception of second segment and claw ; second segment less than half length of first, its tip projecting as a rounded process inside base of claw which is short and slender.

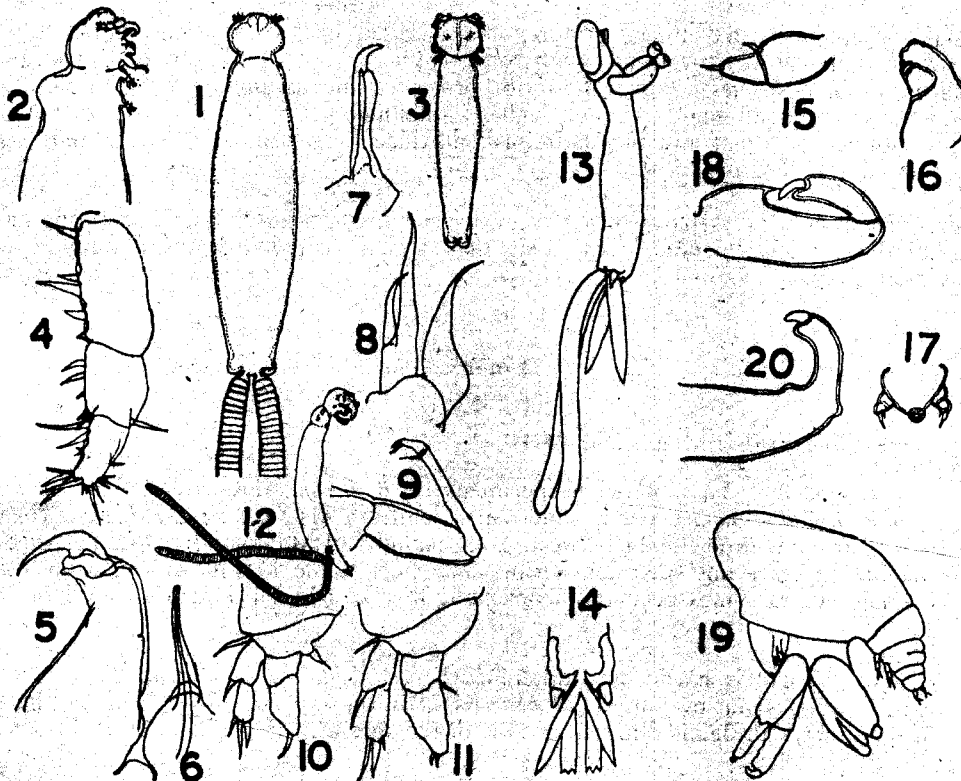


FIG. 34. *Hatschekia mulli* (van Beneden) 1-12. Female. (1) dorsal view, adult ; (2) lateral view of head and thorax ; (3) juvenile, dorsal view ; (4) antennule ; (5) antenna ; (6) spiniform process of base of antenna ; (7) mandible ; (8) maxilla ; (9) maxilliped ; (10) and (11) first and second legs ; (12) adult, lateral view with egg strings. *Charopinus quarternius* Wilson. Female. (13) adult, lateral view ; (14) ventral view of posterior end of trunk ; (15) antennule ; (16) antenna ; (17) mouth tube and maxillule ; (18) maxilliped ; Male. (19) lateral view ; (20) maxilla. (Figures 1-11 after Scott and Scott ; 12 after Causey ; 13-20 after Wilson).

Male.—Dorsal portion of cephalothorax projects far forwards as a large rounded knob, and mouth tube attached to ventral surface at right angles to axis of body ; maxillae in touch

with mouth tube ; first two thoracic segments carry rudimentary legs ; abdomen with slender curved anal laminae ; maxillae and maxillipeds larger than in female to help attachment to female. [Size : female about 5 mm. without processes (from Wilson's figure) ; male 0.35 mm].

Scombroid host : *Scomberomorus cavalla* (Cuvier)

Locality : Grand Isle, Louisiana, U.S.A. (Atlantic).

Non-scombroid hosts : *Coryphaena hippurus*, *Peristedion gracilis* (Dry Tortugas, Atlantic).

Location : Gills.

References : Wilson (1935) ; Causey (1953a).

Genus *Brachiella* Cuvier, 1817

Female.—Cephalothorax elongate, more or less flexed backwards ; with dorsal carapace ; trunk swollen, flattened dorso-ventrally with rows of pits, grooves or knobs on dorsal and ventral surfaces in some species ; 2 or 4 posterior processes and an unpaired genital process ; no abdomen or anal laminae ; egg sacs long, slender ; antennule generally three jointed, but may be two or four jointed as well ; antenna biramous ; maxillae long, usually separate and joined at tips by a bulla, but sometimes fused.

Male.—Cephalothorax separated by a constriction from trunk ; latter fusiform, narrower than cephalothorax, unsegmented, with small anal laminae ; antennule three jointed ; antenna biramous, both rami one jointed.

Brachiella thynni Cuvier, 1817

(Figure 35 : 1-17)

(Syn. *Thynnica ziegleri* Miculicich, 1904).

Material examined : The following specimens of *B. thynni* were collected by us from the Wahoo, *Acanthocybium solandri* (Cuvier and Valenciennes). (1) One female egg-carrying specimen on 10-3-'60 from Wahoo caught between Long Island and Mayabunder, Middle Andamans ; (2) Four female egg-carrying specimens from same host, same locality collected on 12-3-'60 ; (3) Three female egg-carrying specimens from same host caught off Tuticorin, Gulf of Mannar on 23-3-61.

Description : There is hardly any difference between our material and the excellent description of the species given by Shiino (1956). As such, only the salient features of the species are given here, along with detailed measurements of the specimens in the collection in a separate table.

Female.—Body is highly degenerate and consists of two divisions, anterior cylindrical cephalothorax and posterior shield-shaped trunk ; at junction of these two divisions is present a pair of processes (maxillae) which help in attaching to the host ; posterior end of trunk bears two pairs of fleshy prolongations, ventro-caudal and dorso-caudal processes ; trunk divided into a few indistinct segments marked by constrictions ; all appendages, except maxillipeds concentrated in anterior end of cephalothorax.

Shiino (1956) gives 9.30 and 8.58 mm. as the lengths of the ventro-caudal and dorso-caudal processes respectively. Specimens in our collection appear to be smaller in this respect and

also show reverse relations in the relative lengths of these processes, the ventro-caudal processes being longer than the dorso-caudal processes.

The measurements of 6 of the specimens are given in Table 3.

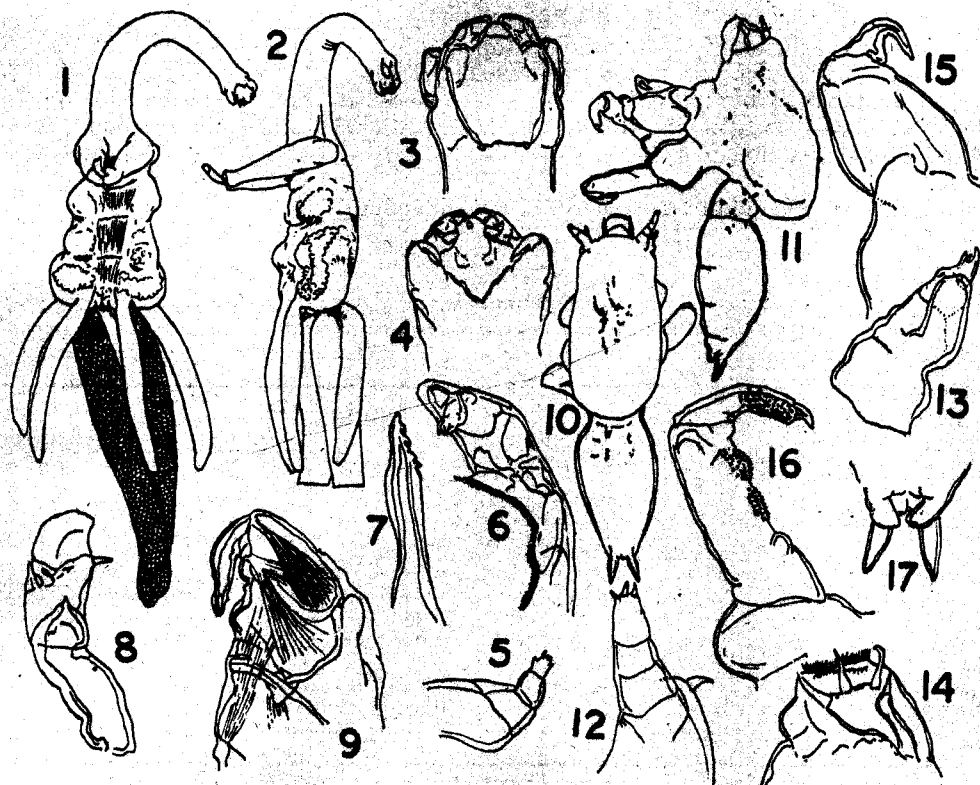


FIG. 35. *Brachiella thynni* Cuvier. Female. (1) ventral view; (2) lateral view; (3) carapace, dorsal view; (4) same ventral view; (5) antennule; (6) antenna; (7) mandible; (8) maxilla; (9) maxilliped: Male. (10) dorsal view; (11) lateral view; (12) antennule; (13) antenna; (14) proboscis and maxillule; (15) maxilla; (16) maxilliped; (17) caudal laminae (after Shiino).

Males.—All salient characteristics can be made out from Shiino's drawing of the species reproduced here.

- Scombroid hosts* :
1. *Thynnus thynnus* [= *Thunnus* (*Thunnus*) *thynnus thynnus* (Linnaeus)]
 2. *Orcynus thynnus* [= -do-]
 3. *Thunnus* (*Germo*) *macropterus* [= *Thunnus* (*Neothunnus*) *albacares macropterus* (Temminck and Schlegel)]
 4. *Acanthocybium solandri* (Cuvier and Valenciennes)
 5. *Scomberomorus cavalla* (Cuvier)
 6. *Acanthocybium solandri* (Cuvier and Valenciennes)

Localities : 1. Adriatic, Mediterranean and British Seas; Atlantic. 2. British Seas; 3. Ceylon; 4. Owase, Mie Prefecture, Japan; and Cocos Island, E. Pacific; 5. Texas Coast, U.S.A., and Gulf of Mexico; 6. Andaman Islands, Bay of Bengal and Tuticorin, Gulf of Mannar, India.

Non-scombroid hosts : *Sciaena aquila* (British Seas); *S. umbra* (Belgian coast); *Pomatomus saltatrix* (Gulf of Mexico).

Locations : Gills and pectoral fins and their axils.

References : Cuvier (1817); Guerin-Meneville (1829-'43); Nordmann (1832); Milne Edwards (1840); van Beneden (1851); Steenstrup and Lutken (1861); Heller (1865); Vogt (1877); Bassett-Smith (1896, 1899); Graeffe (1902); Stenta (1904); Miculicich (1904, 1905); Norman and Scott, T. (1906); Brian (1906); Scott and Scott (1913); Wilson (1915); Leigh-Sharpe (1926); Kirtisinghe (1935); Bere (1936); Causey (1953); Delamare-Deboutteville and Nunes-Ruivo (1954); Shiino (1956, 1960).

Remarks : A recent additional record, see 'Addendum'.

TABLE 3

Body measurements expressed as percentages of total length (excluding processes) in six specimens of *Brachiella thynni* Cuvier collected from *Acanthocybium solandri* (Cuvier and Valenciennes) from Indian seas.

Characters	Specimens *					
	1	2	3	4	5	6
Length, cephalothorax ..	68.04	65.13	64.71	66.92	59.59	68.11
Length, trunk ..	31.96	34.87	35.29	33.08	40.41	31.89
Width, cephalothorax ..	6.87	6.90	9.40	7.14	9.84	10.27
Width, trunk ..	19.59	20.31	27.06	20.30	25.39	24.86
Ventro-caudal process ..	54.30	50.57	47.06	56.39	63.73	58.38
Dorso-caudal process ..	33.68	35.25	32.25	34.94	45.60	48.65
Length, maxilliped ..	20.27	21.84	18.82	20.68	20.21	17.84
Right egg string ..	63.92	67.05	50.59	broken	80.83	71.89
Left egg string ..	61.16	65.13	49.41	broken	75.65	67.57

* Host individuals of specimens 1-4 taken at Andamans in March, 1960, and of 5 and 6 at Tuticorin in March 1961.

Brachiella ramosa Richiardi, 1880

Scombroid host : *Xiphias gladius* Linnaeus.

Locality : Woods Hole, Massachusetts, U.S.A. (N.W. Atlantic).

Non-scombroid hosts : ? None.

Location : Gills.

References : Richiardi (1880); Goode (1883); Rathbun, M. J. (1905); Sumner *et al.* (1913).

Genus *Clavellisa* Wilson, 1915

Female.—Cephalothorax much longer than trunk, often wrinkled, attached to centre of dorsal surface of latter; head separated from neck with carapace; trunk wider than long, depressed; genital, posterior processes, abdomen and anal laminae absent; antennule stout, heavily

armed ; antennae biramous ; maxillule bipartite or tripartite with a palp ; maxillae flat and laminate, fused or separate, apparently attached to anterior end of trunk, some distance in front of base of neck.

Male.—Head folded ventrally into trunk, both completely fused, with no distinction of parts, but with a dorsal carapace ; body ovoid, pointed anteriorly ; antennae, mouth tube and mouth parts on ventral surface ; genital process curved ventrally projecting just behind mouth parts ; antennule three segmented ; antennae biramous ; rami one segmented ; maxillule tripartite with a palp ; maxillae and maxillipeds with strong apical claws.

Clavellisa scombri (Kurz, 1877)

(Syn. *Anchorella scombri* Kurz, 1877)

Scombroid host : 1. *Scomber colias* [= *S. japonicus colias* Gmelin]
2. *Scomber scombrus japonicus* [= *Scomber japonicus japonicus* Houttuyn]

Localities : 1. Portoferraio, Italy, Mediterranean ; 2. Tsunodayama, Niigata Prefecture, Japan.

Non-scombroid hosts : ? None.

Location : Gills.

References : Kurz (1877) ; Brian (1922) ; Yamaguti (1939) ; Shiino (1959b).

Family : ANTHEACHERIDAE

Genus *Philichthys* Steenstrup, 1862

Female.—Head small, rounded, without carapace and separated from first segment ; neck absent ; trunk elongated, narrowing posteriorly and distinctly segmented ; each segment subdivided and all including head furnished with a number of lateral and ventral processes, moderately slender, and more or less curved downwards and inwards upon ventral aspect ; no plates on segments ; anterior thorax swollen and orbicular, posterior part cylindrical and tapering backwards ; abdomen short and segmented ; anal laminae wanting, so also antennae, mouth parts and swimming legs, but a single median eye spot present.

Male.—Much smaller ; body slender, distinctly segmented ; head separated from first segment, without carapace and of same width as first and second segments ; remaining thoracic segments markedly narrower than aforesaid and insensibly passes into abdomen consisting of four segments ; anal laminae long and cylindrical ; antennule six segmented ; antennae two segmented, each provided with 2 hook-like claws ; maxillae stout, armed with strong spines ; maxillipeds feeble.

Philichthys xiphae Steenstrup, 1862

(Figure 36 : 1-4)

Description : Female.—Mainly as for genus except : anterior portion of cephalothorax consisting of three small segments, first very minute, second moderate with median eye spot dorsally and mouth aperture ventrally ; anteriorly a knob like process on each side of first segment ;

second segment larger with two dorsal processes on each side; body immediately posterior to front portion of cephalothorax more tumid, and expanding equally on either side to form a nearly circular disc, width of which is more than one-third total length; each segment with a pair of irregularly branched ventral processes; fourth, fifth and genital segments of about same width, but much narrower than expanded circular disc anteriorly; each segment with one or more pairs of lateral processes which surround ovisacs; abdomen three segmented, median segment only half as wide as other two; terminal abdominal segment swollen at base with a pair of knobs on dorsal surface and long dactylose posterior processes; each abdominal segment with a pair of lateral and a pair of ventral processes; ovisacs fairly elongate, extending forward as well as backward along ventral aspect and enclosed and supported by curved lateral and ventral processes; egg strings not extending behind posterior end of body. Length from 14.5 to 27.0 mm.

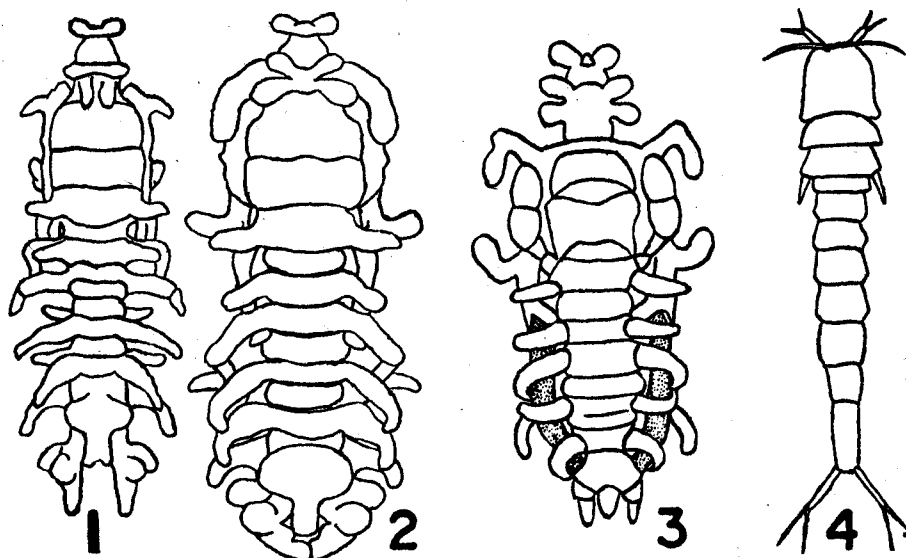


FIG. 36. *Philichthys xiphae* Steenstrup. Female. (1) dorsal view of young specimen; (2) female, older specimen, both from English seas; (3) dorsal view of female with eggs; (4) dorsal view of male, both from N. W. Atlantic; note variation in female (after Scott; and Wilson).

Male.—As given for genus and: second thoracic segment armed with a stout curved spine at each postero-lateral angle; genital segment a little longer, but not wider than fifth segment; anal laminae five times as long as wide, tipped with two setae of equal length; two pairs of biramous swimming legs, exopod two segmented, endopod one segmented, both rami well armed with spines and setae. Total length 4.0 to 6.0 mm.

Scombroid host: *Xiphias gladius* Linnaeus.

Localities: Kattegat; Mediterranean; English seas; New England Coast of U.S.A.; New Zealand.

Non-scombroid hosts: None.

Location: Living freely in mucus canal and sinuses of host.

References: Steenstrup (1862); Bergose (1864); Richiardi (1880); Valle (1880); Carus (1885); Scott and Scott (1913); Goode (1883); Rathbun M. J. (1905); Linton (1901); Sumner *et al.* (1913); Thompson (1885); Wilson (1932); Delamare-Deboutteville and Nunes-Ruivo (1952).

HOST—PARASITE LIST

(Generic names of host and parasite species are alphabetically arranged ; a query (?) accompanying the parasite species indicates that the host record is doubtful)

HOST SPECIES	PARASITE SPECIES
<i>Acanthocybium solandri</i> (Cuvier and Valenciennes)	<i>Brachiella thynni</i> Cuvier <i>Gloiopotes hygomianus</i> Steenstrup and Lutken
<i>Auxis thazard</i> (Lacépède).....	<i>Caligus macarovi</i> Gussev <i>Caligus productus</i> Dana
<i>Euthynnus affinis affinis</i> (Cantor).....	? <i>Anuretes branchialis</i> Rangnekar
<i>Euthynnus affinis lineatus</i> Kishinouye.....	<i>Caligus caryphaenae</i> Steenstrup and Lutken <i>Caligus macarovi</i> Gussev
<i>Euthynnus affinis yaito</i> Kishinouye.....	<i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus regalis</i> Leigh-Sharpe <i>Pseudocycnus appendiculatus</i> Heller
<i>Euthynnus alletteratus</i> (Rafinesque).....	<i>Caligus bonito</i> Wilson <i>Pseudocycnus appendiculatus</i> Heller <i>Caligus coryphaenae</i> Steenstrup and Lutken
<i>Istiophorus gladius</i> (Broussonnet).....	<i>Caligus quadratus</i> Shiino <i>Caligus</i> sp. (Silas and Ummerkutty—in this account) <i>Gloiopotes costatus</i> Wilson <i>Gloiopotes longicaudatus</i> (Marukawa) <i>Gloiopotes watsoni</i> Kirtisinghe <i>Pennella filosa</i> (Linnaeus) <i>Pennella instructa</i> Wilson
<i>Katsuwonus pelamis</i> (Linnaeus).....	? <i>Anuretes branchialis</i> Rangnekar <i>Caligus bonito</i> Wilson <i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus kurushio</i> Shiino <i>Caligus mutabilis</i> Wilson <i>Caligus pelamydis</i> Kroyer <i>Caligus productus</i> Dana <i>Caligus quadratus</i> Shiino <i>Caligus thynni</i> Dana <i>Lepeophtheirus dissimulatus</i> Wilson
<i>Kishinoella tonggol</i> (Bleeker).....	<i>Pseudocycnus appendiculatus</i> Heller
<i>Makaira audax</i> (Philippi).....	<i>Elytrophora indica</i> Shiino <i>Gloiopotes longicaudatus</i> (Marukawa) <i>Gloiopotes ornatus</i> Wilson
<i>Makaira indica</i> (Cuvier).....	<i>Gloiopotes longicaudatus</i> (Marukawa) <i>Lepeophtheirus eminens</i> Wilson <i>Pennella biloba</i> Kirtisinghe

<i>Makaira nigricans</i> (Lacépède).....	<i>Gloiopotes longicaudatus</i> (Marukawa)
<i>Makaira</i> sp.....	<i>Gloiopotes costatus</i> Wilson ? <i>Gloiopotes longicaudatus</i> (Marukawa) (= <i>G. zeugopteri</i> Rao, 1951)
<i>Rastrelliger kanagurta</i> (Cuvier).....	? <i>Lernaeenicus</i> sp. (Rao, 1951)
<i>Rastrelliger</i> sp.....	? <i>Caligus infestans</i> Heller
<i>Sarda chilensis chilensis</i> (Cuvier and Valenciennes)	<i>Caligus bonito</i> Wilson <i>Caligus mutabilis</i> Wilson <i>Pseudocycnus appendiculatus</i> Heller
<i>Sarda orientalis</i> (Temminck and Schlegel)....	<i>Alicalgus tripartitus</i> Shiino <i>Caligus bonito</i> Wilson <i>Parapetalus</i> sp. (Silas and Ummerkutty—in this paper)
<i>Sarda sarda</i> (Bloch).....	<i>Alebion glaber</i> Wilson <i>Alebion gracilis</i> Wilson <i>Caligus bonito</i> Wilson <i>Caligus mutabilis</i> Wilson <i>Caligus pelamydis</i> Kroyer <i>Caligus productus</i> Dana <i>Pseudocycnus appendiculatus</i> Heller
<i>Sarda</i> sp.....	<i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus productus</i> Dana
<i>Scomber japonicus colias</i> Gmelin.....	<i>Caligus productus</i> Dana <i>Clavellisa scombri</i> (Kurz) (= <i>Anchorella scombri</i> Kurz)
<i>Scomber japonicus japonicus</i> Houttuyn.....	<i>Clavellisa scombri</i> (Kurz) <i>Clavellopsis saba</i> Yamaguti
<i>Scomber japonicus</i> sub sp.....	<i>Caligus infestans</i> Heller <i>Lepeophtheirus dissimulatus</i> Wilson
<i>Scomber scombrus</i> Linnaeus.....	<i>Caligus pelamydis</i> Kroyer <i>Caligus rapax</i> Milne Edwards
<i>Scomber</i> sp.	<i>Caligus productus</i> Dana
<i>Scomberomorus cavalla</i> (Cuvier).....	<i>Brachiella thynni</i> Cuvier <i>Caligus bonito</i> Wilson <i>Caligus pelamydis</i> Kroyer <i>Caligus productus</i> Dana <i>Caligus rapax</i> Milne Edwards <i>Charopinus quaternius</i> Wilson <i>Hatschekia mulli</i> van Beneden <i>Pseudocycnus buccatus</i> Wilson

<i>Scomberomorus commerson</i> (Lacépède).....	<i>Pseudocycnus armatus</i> (Bassett-Smith)
<i>Scomberomorus guttatus guttatus</i> (Bloch and Schneider).....	<i>Caligus cybii</i> Bassett-Smith <i>Pseudocycnus armatus</i> (Bassett-Smith)
<i>Scomberomorus maculatus</i> (Mitchill).....	<i>Caligus bonito</i> Wilson <i>Caligus mutabilis</i> Wilson <i>Caligus productus</i> Dana <i>Caligus rapax</i> Milne Edwards <i>Lernaeenicus longiventris</i> Wilson <i>Pseudocycnus buccatus</i> Wilson <i>Pseudocycnus elongatus</i> (Pearse)
<i>Scomberomorus regalis</i> (Bloch).....	<i>Pseudocycnus buccatus</i> Wilson
<i>Scomberomorus</i> sp. (<i>S. tritor</i>).....	<i>Caligus bonito</i> Wilson
<i>Scomberomorus</i> spp.	<i>Pseudocycnus spinosus</i> Pearse <i>Lernaeenicus seeri</i> Kirtisinghe
<i>Tetrapterus belone</i> Rafinesque.....	<i>Gloiopotes ornatus</i> Wilson
<i>Thunnus</i> (<i>Thunnus</i>) <i>alalunga</i> (Bonnaterre)....	<i>Caligus alalongae</i> Kroyer <i>Caligus germoi</i> Pearse <i>Elytrophora brachyptera</i> Gerstaecker <i>Euryphorus nympha</i> Steenstrup and Lutken <i>Lernanthropus hiatus</i> Pearse <i>Pennella orthagorisci</i> Wright <i>Pseudocycnus appendiculatus</i> Heller
<i>Thunnus</i> (<i>Thunnus</i>) <i>thynnus orientalis</i> (Temminck and Schlegel).....	<i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus kuroshio</i> Shiino <i>Caligus productus</i> Dana <i>Elytrophora brachyptera</i> Gerstaecker <i>Elytrophora hemiptera</i> Wilson
<i>Thunnus</i> (<i>Thunnus</i>) <i>thynnus thynnus</i> (Linnaeus)	<i>Brachiella thynni</i> Cuvier <i>Elytrophora atlantica</i> Wilson <i>Elytrophora brachyptera</i> Gerstaecker <i>Pseudocycnus appendiculatus</i> Heller
<i>Thunnus</i> (<i>Neothunnus</i>) <i>albacares macropterus</i> (Temminck and Schlegel).....	<i>Brachiella thynni</i> Cuvier <i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus productus</i> Dana <i>Caligus quadratus</i> Shiino <i>Elytrophora brachyptera</i> Gerstaecker <i>Elytrophora hemiptera</i> Wilson <i>Euryphorus nympha</i> Steenstrup and Lutken <i>Pseudocycnus appendiculatus</i> Heller
<i>Thunnus</i> (<i>Parathunnus</i>) <i>obeseus mebachi</i> (Kishinouye)*	<i>Elytrophora brachyptera</i> Gerstaecker

<i>Thunnus</i> (<i>Parathunnus</i>) <i>obesus sibi</i> (Temminck and Schlegel)*	<i>Elytrophora brachyptera</i> Gerstaecker
<i>Thunnus</i> (<i>Thunnus</i>) sp.	<i>Cerops latrellii</i> Leach <i>Pennella filosa</i> (Linnaeus)
<i>Thunnus</i> sp.	<i>Chondracanthus lophii</i> Johnston
<i>Xiphias gladius</i> Linnaeus	<i>Brachiella ramosa</i> Richiardi <i>Brachiella thynni</i> Cuvier <i>Caligus chelifera</i> Wilson <i>Caligus rapax</i> Milne Edwards <i>Chondracanthus xiphiae</i> (Guerin) ? Cuvier <i>Gloiopotes ornatus</i> Wilson <i>Pennella crassicornis</i> Steenstrup <i>Pennella costal</i> Richiardi <i>Pennella filosa</i> (Linnaeus) <i>Pennella instricta</i> Wilson <i>Philichthys xiphiae</i> Steenstrup

* It is likely that *mebachii* and *sibi* may be identical, and if so, the latter name has priority.

REFERENCES

- BAIRD, W. 1850. The natural history of the British Entomostraca. *Ray Society*. London.
- BARNARD, K. H. 1948. New records and descriptions of parasitic copepods from South Africa. *Ann. Mag. Nat. Hist.*, ser. 12, 1 : 242-54.
- . 1955. South African parasitic copepoda. *Ann. S. Afr. Mus.*, 41 : 223-312.
- BASSETT-SMITH, P. W. 1896. List of parasitic copepoda of fish obtained at Plymouth. *J. Mar. biol. Assoc. U.K.*, (n.s.), 4 : 153-63.
- . 1896. Notes on the parasitic copepoda of fish obtained at Plymouth with descriptions of new species. *Ann. Mag. Nat. Hist.*, (6) 18 : 8-16.
- . 1898. New parasitic copepods found on fish at Bombay. *Ibid.*, ser. 7, 1 : 1-17.
- . 1898. Further new parasitic copepods found on fishes in the Indo-Tropical region. *Ibid.*, ser. 7, 2 : 77-98.
- . 1898. Some new or rare parasitic copepods found on fish in the Indo-Tropical region. *Ibid.*, ser. 7, 2 : 357-72.
- . 1899. A systematic description of parasitic copepoda found on fishes, with an enumeration of known species. *Proc. Zool. Soc. London*, 1899, 438-507.
- BENEDEN, G. J. van 1851. Recherches sur quelques crustacés inférieurs. *Ann. Sci. Nat.* (3) Zool. 16 : 71-131, pls., 2-6.
- . 1871. Les Poissons des Côtes de Belgique, leurs parasites et leurs commensaux. *Mem. Acad. R. Belgique* (for 1870) 38 : 100 pp. 6pls.
- BERE, R. 1936. Parasitic copepods from the Gulf of Mexico fish. *Amer. Midl. Nat.*, 17 : 577-625.
- BERGSOE, V. 1864. *Philichthys xiphiae* stp., *Monographisk Fremstillet.-Naturthirt. Tidsskrift*, 3 Rack, 3 Bind, pp. 87-130, tab. 13, Kjöbenhavn ; (oppure *Ann. Sci. Natur.* 5 ser. Zoologie, 3 : 213, pl. 1, 1865).
- BLAINVILLE, H. M. D. de 1822. Mémoires sur les Lernees. *Journ. de Physique*, T. 95 : 372-80 ; 437-47 ; pl. 1.
- BRADY, G. S. 1883. Report on the Copepoda (including copepoda parasitic on fishes). *Voyage of H.M.S. 'Challenger'*. Zool. 7 : pt. 23.

- . 1910. Die Marinen copepoden der deutschen Sudpolar Expedition 1901-1903. I. Über die copepoden der Sramme Harpacticoida, Cyclopoida, Notodelphyoida und Caligoida. *Deutsche Sudpolar Exped.* 1901-1903, 2(5) : 497-593, pls. 1-12.
- BRANDES, C. H. 1955. Über eine neue Art der parasitischen Copepoden : *Pseudocycnus thynnus* n. sp. *Veroot Inst. Meersf. Bremerhaven*, 3(2) : 190-92, 2 figs.
- BRIAN, A. 1898. Note preliminaire sur les copepoda parasites des Poissons. *Bull. Inst. Oceanogr.* No. 110 : 19.
- . 1901. Caso di anomalia verificattosi sui di una 'Brachiella' del tonno. *Boll. Mus. Zool. Anat. Comp. Univ. Genova*, No. 104 : 1-3.
- . 1901. Un cas de monstruosite constants sur une brachiella del thon. *Cosmos*, n.s. 50, No. 832 : 10-11.
- . 1903. Sui copepodi parassiti di pesci marini dell 'Iola d ' Elba. *Attl. Soc. Ligustica Sci. Nat. e Geogr.*, 13 : 1-8.
- . 1905. Sui copepodi raccolti nel Golfo di Napoli da Oronzio G. e da Achille Costa (con 2 tavole). *Annuario del Museo Zoologico dela R. Universita di Napoli*. N. 24, n.s. 1 con. tav. Gennaio.
- . 1906. Copepodi parassiti dei Pesci d'Italia. 189 pp. Genova.
- . 1908. Note prelim. sur le copepodes parasites provenant des campagnes scient. de S.A.S. le Prince de Monaco. *Bull. de l'Institut Oceanogr.* No. 110, Janvier 31.
- . 1908. La presenza del *Caligus rapax* (Copepodo Parassita) nel Mediterraneo. *Boll. del Naturalista*, Anno 68, N. 11-12. Siena.
- . 1912. Copepodes parasites des poissons et des echinides provenant des campagnes scientifiques de S.A.S le Prince Albert ler de Monaco(1889-1910). *Res. Comp. Sci. Monaco*, 38 : 10-11, 16.
- . 1924. Parasitologia mauritanica copepoda. *Bull. du Comite d' etudes Hist. et Sci. de l'Afriques Occident.*, France, Fasc. 1.
- . 1927. Crustacea II Copepoda parassitica, in Theodore Monod : Contribution a l'etude de la Faune du Cameroun. Premiere partie. *Faunae des Colonies Francaises*, Paris, t.I, fasc. 6 : 57-587, figs. 1-34.
- . 1935. I. *Caligus* parassiti di pesci del Mediteraneo (Copepodi). *Ann. Mus. Civ. Stor. Nat. Genova*, 51 : 152-211.
- . 1939. A note morfologiche sulla *Dimentura producta* (Mull.). *Boll. Mus. Zool. Anat. Cong. Genova*, 19 (115) : 1-28.
- CAPARAT, A. 1941. Resultats scientifiques des croiseres du nabire-ecole Balge 'Mercator' Vol. 3 : V. Copepodes Prasitica. *Mem. Mus. Roy. d'Hist. Nat. Belg.*, (2), fasc. 21 : 171-197.
- . 1953. Quelques copepodes parasites des poissons marino de la region de Dakar. *Bull. d'Inst. Fr. Afr. Noire*, 15 : 647-671.
- CARUS, J. V. 1884. *Prodromus faunae Mediterraneae*. Pt. 1 : 345-378, Stuttgart.
- CARVALHO, J. de P. 1950. Occurenica de *Pseudocycnus appendiculatus* Heller Copepodo de familis Pseudocycnidae em aguas de littoral Paulista. *Biol. Inst. Paul. Oceanogr.*, 1(2) : 99-102.
- . 1951. Notas sobres alguna copepodos parasitos de peisces maritimos da costa do estado de Sao Paulo. *Bol. Inst. Paulista de Oceanogr.*, 2 : 135-144.
- . 1953. Nota sobre *Lernaeenicus longiventris* Wilson e sua ocorrencia em *Xenomelanius brasillensi* (Quoy and Gaimard) (Crust. Copepoda-Pisces, Atherinidae). *Ibid.*, 4 (1-2) : 181-190.
- CAUSEY, 1953. Parasitic copepoda from Grand Isle, Louisiana. *Occ. Pap. Mar. Lab. Louisiana State Univ.*, No. 7 : 1-18.
- . 1953. Parasitic Copepoda of Texas coastal fishes. *Publ. Inst. Mar. Sci.*, 3 : 7-16.
- . 1955. Parasitic Copepoda from Gulf of Mexico fish. *Occ. Pap. Mar. Lab. Louisiana State Univ.*, No. 9 : 1-19.
- . 1960. Parasitic Copepoda from Mexican Coastal fishes. *Bull. Mar. Sci. Gulf Caribbean*, 10(3) : 323-337.

- CRANE, J. 1936. Notes on the biology and ecology of giant tuna *Thunnus thynnus* Linnaeus, observed at Portland, Maine. *Zoologica, N.Y.* **21** : 207-12.
- CUNNINGHAM, J. T. 1893. Notes on rare or interesting specimens. *J. Mar. Biol. Assoc. U.K.*, 1893-95, n.s. **3** : 276.
- CUVIER, G. L. 1817. *Regne Animal*. Premiere Ed. Tan. **3** : 60-66. Paris.
- . 1829. *Regne Animal*. Nouvelle Ed. Tom. **4** : 189-202. Paris.
- CUVIER, G. AND A. VALENCIENNES, 1831. *Histoire naturelle des Poissons*. Paris. **8** : 57-137, 255.
- DANA, J. D. 1852. United States Exploring Expedition during the years 1838-1842, under the command of Charles Wilkes. U.S.N. 13, Crustacea. (Atlas Crustacea, Philadelphia, 1855).
- DELAMARE-DEBOUTTEVILLE, C. 1950. Sur la biologie des Chondracanthidae (Crustaces Copepodes). *C.R.Ac. Sci. Paris*, **232** : 117-119.
- , AND L. P. NUNES-RUIVO. 1952. Copepodes Philichthyidae nouveaux, parasites de poissons Europeans. *Ann. Parasit. Hum. Comp.* **27** : 598-609.
- . 1954. Parasites de Poissons de Mer ouest-africains recoltés par M. J. Cadenat, II. Copepodes (1^{note}) genres *Lernanthropus*, *Sagum*, *Paeon*, *Pennella*. *Bull. d'Inst. Franc. Afrid. Noire*, **16** : 139-166.
- . 1954. Copepodes parasites des poissons Méditerranéens (3^{ser.}) (1). *Vie et Milieu*, **4** : 201-217.
- DELAROCHE, F. 1811. Sur deux animaux vivants sur les branchies des poissons. *Nouv. Bull. Soc. Philomat.* **2** : 270-272.
- EDWARDS, H. MILNE. 1840. *Histoire naturelle des crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux*. Paris.
- ELLIS, J. 1763. *Philos. Trans.*, **53** : 433.
- ELWES, E. V. 1909. Sunfish and its parasites. *Journ. Torquay Nat. Hist. Soc.*, **1**(1) : 17-20.
- FREY, H., AND R. LEUCKART, 1847. Beitrag zur kenntniss wirbellosen Thiere. p. 165.
- GERSTAECKER, A. D. 1853-54. Ueber eine neue und eine weniger gekannte Siphonostomen-Gattung, und Beschreibung zweier neuer Siphonostomen Gattungen. *Weigmann's Archiv. f. Naturg.* **19**(1) : 58-70 ; **20** : 185-195.
- GIARD, A. 1889. Sur l'association de *Pennella orthagorisci* Percival Wright, et de *Chonchodesma virgatum* Spengl. *Le Naturalista* (2) **3**, No. **50** : 82.
- GNANAMUTHU, C. P. 1949. Two male parasitic copepods from Madras. *Ann. Mag. Nat. Hist.*, **2** : 359-367.
- . 1950. Two dichelesthiid copepods from Madras fish. *Parasitology*, **40** : 276-282.
- . 1950. *Parapetalus caudatus* n. sp. a copepod parasite on *Dussumeria acuta* from Madras. *Proc. Indian Acad. Sci.*, **31**(2) : 125.
- GOODE, G. B. 1883. Materials for a history of the swordfish. *Rept. U.S. Fish. Comm.*, 1880, pp. 289-387, pls. 1-24.
- GRAFFE, E. 1902. Übersicht der Fauna des Golfes von Triest nebst Notizen über Vorkommen, Lebensweise, Erscheinungs- und Laichzeit der einzelnen Arten. *Arb. Zool. Inst. Univ. Wien.*, **13** : 33-80.
- GUERIN-MENEVILLE, F. E. 1829-43. *Iconographie du Règne animal*. Crustacés. (Text, 1844).
- GUIART, J. 1913. Crustacés commensaux et parasites de la baie de Concarneau. *Bull. Inst. Oceanogr. Monaco*, **264** : 1-11.
- GUSSEV, A. V. 1951. Paraziticheskie Copepoda s nekotorykh Morskikh Ryb. Parazitol. *Sborn. Zoolog. Inst. Akad. Nauk. SSSR*, **13** : 394-403.
- HANSEN, H. J. 1923. Crustacea Copepoda II. Copepoda parasita and hemiparasita. *The Danish Ingolf Exped.*, **3** (No. 7) : pp. ii, 92, ii, pls. 5.
- HEEGAARD, P. E. 1943. Parasitic copepods mainly from Tropical and Antarctic Seas. *Ark. Zool.*, **34 A** (18) : 1-37.
- . 1949. Notes on parasitic copepods. *Vidensk. Medd. fra Dansk Naturh. Foren.*, **111** : 235-245.

- . 1953. Some parasitic copepods from fishes in the Uppsala University collections. *Ark. Zool.*, 35A(18): 1-27.
- . 1955. Parasitic copepods from Tropical West Africa. *Atlantide Rept.* No. 3 : 41-56.
- HELLER, C. 1865. *Crustaceen der Novara Expedition.*
- HOEVEN, J. VAN DER. 1857. Notes sur les genres *Cecrops* et *Lemargus*. *Memoires d'Entomol. de la Soc. Entom. du Pays-bas*, 1 : 67-87.
- HOFER, B. 1904. Handbuch der Fischkrankheiten. *Verlag der allg. Fischerel-Zeitung.* Muchen.
- JOHNSTON, G. 1836. *Chondracanthus lophii*, nov., spec. *Mag. Nat. Hist. London*, 9 : 81-83.
- KIRTISINGHE, P. 1932. *Pennella zeylanica* n. sp. A parasitic copepod of *Histiophorus gladius* Day. *Parasitology*, 24(1) : 137-139.
- . 1933. Two new parasitic copepods from Ceylon. *Ibid.*, 24(4) : 548-51.
- . 1934. *Gloiopotes watsoni* n. sp. and *Lernaeenicus seeri* n. sp. parasitic copepods of fish from Ceylon. *Ibid.*, 26 : 167-175.
- . 1935. Parasitic copepods of fish from Ceylon. *Ibid.*, 27 : 339-342.
- . 1937. Parasitic copepods of fish from Ceylon II. *Ibid.*, 29 : 435-52.
- . 1937. On the genus *Cybicola* Bassett-Smith (1898). *Ibid.*, 29(4) : 435-56.
- . 1950. Parasitic copepods of fish from Ceylon III. *Ibid.*, 40 : 77-86.
- . 1956. Parasitic copepods of fish from Ceylon IV. *Ibid.*, 46 : 14-21.
- KLINBERG, C. G. A. 1942. *Pseudocycnus appendiculatus* Heller, a dichelesteiid new for Swedish waters. *Kungl. Fysiol. Selsk. Lund. Forhandl.*, 12(5) : 1-5.
- KOLLAR, V. 1835. Beitrage zur kenntniss lernaeenartigen crustacean. *Annal. des Wiener Museum fur Nat.*, 1(1) : 72-92.
- KROYER, H. 1837-38. Om Synltekrebsene, især med Hensyn til den dansk Fauna.—Naturhistorisk Tidsskrift, Vol. 1. pp. 172-208, pp. 252-304, pp. 476-505, pp. 605-628. tab. 2-3 & 5-6. Vol. 2, pp. 8-52, pp. 131-157, tab. 1 & 3. Kjöbenhavn.
- . 1863. Bidrag till kundskab om snyltekrebsene Naturhistorisk Tidsskrift, 3 die Raekke, 2 : 75-426, tab. 1-18. Separat : Kjöbenhavn.
- KURZ, W. 1877. Studien über die Familie der Lernaeopodiden. *Zeitschr. f. Wiss. Zool.*, bd.29.
- LEACH, W. E. 1814. Crustaceology (in *Edinburg Encyclopedia*).
- . 1816. Supplement—Annilosa (*ibid.*).
- LE GALL, J. 1949. Germon. Resume des connaissances acquises sur la biologie due germon. *Rev. Trav. off. Peches Marit.*, 15 : 1-42.
- LEIGH, SHARPE, W. H. 1928. The genus *Pennella* as represented by the collection in the British Museum. *Parasitology*, 20.
- . 1930. Parasitic copepoda, in Resultats Scientifiques du voyage aux Indes Orientales Neerlandaises de in Prince et la Princesse Leopold de Belgique. *Bruxelles*, 3(2) : 1-9, 5 pls.
- . 1933. A list of British fishes with their characteristic parasitic copepoda. *Parasitology*, 25 : 109-112.
- LUBBOCK, J. 1860. On some oceanic Entomostraca collected by Capt. Toynbee. *Trans. Linn. Soc. London*, 23 : 173-192, pl. 29.
- MACINTOSH, W. C. 1863. Note on the food and parasites of the *Salmo salar* Linn. of the Tay. *J. Linn. Soc. London, Zool.*, 7 : 145-54.
- MARUKAWA, H. 1925. *Illustrated Encyclopedia of the Fauna of Japan.* Tokyo, 1243. Abb. 2396.

- MICULICICH, M. 1905. Eien neuer Lernaepodidae. *Zool. Anz.*, 28 : 47-52.
- . 1905. Zur kenntnis der Gattung *Brachiella* Cuv. und der Organsation der Lernaepodiden. *Zool. Anz.*, 28 : 599-620.
- . 1905. Weiter Mitteilungen zur kenntnis der Gattung *Brachiella* Cuv. *ibid.*, 733-36.
- MILNE-EDWARDS, H. 1840. Histoire naturelle des crustacés, Comprenant l'anatomie, la physiologie, et la classification de ces animaux. Paris.
- MOULSE, LEON. 1908. La parasitologie dans la littérature antique. Crustace parasite des thons et des espondons. *Arch. Parasit.*, 13 : 260-62.
- MULLER, O. F. 1785. *Entomostraca, seu Insecta testacea quae in aquis Daniae et Norvegiae reperit, descriptit, et iconibus illustravit. Lipsiae et Hafniae.* (Leipzig and Copenhagen.)
- NERESHEIMER, E. 1909. Studien uber suesswasser Lernaepoden. *Ber. Bayr. biol. Versuchsstat, Munchen.*, 2 : 1-9.
- NORDMANN, A. 1832. *Mikrographische Beitrage zur Naturgeschichte ger wirbellosen Thiere*, 2 Hefte. Berlin.
- . 1864. Neue Beitrage zur kenntnis parasiticher Copepoden. Erster Beitrag. *Bull. de la Soc. des Natur. de Moscou*, 37(2) : 461-520.
- NORMAN, A. M., AND T. SCOTT. 1906. *Crustacea of Devon and Cornwall.* London.
- NUNES-RUIVO, L. 1956. Copepodes parasites de peixes dos mares de Angola. *Annis de Junia de Invest. de Ultramar.*, 9(2) : 1-39.
- , AND P. FOURNANOIR. 1956. Copepodes parasites poissons de Madagascar. *Mem. de l'Inst. Sci. Madagascar, Ser. A.* 10 : 69-80.
- OAKLEY, C. L. 1930. The Chondracanthidae (Crustacea : Copepoda) ; with a description of five new genera and one new species. *Parasitology*, 22 : 182-201.
- OKEN, L. 1815. *Lehrbuch der Naturgeschichte* Th. III, p. 184, ff. und p. 357.
- OLSSON, P. 1868. Prodrum faunae Copepodorum parasitantium Scandinaviae. *Lunds Univ. Aarsk.*, 5 (art, 8) : 1-49.
- PARONA, C. 1919. Il tonno e la sua pesca. *Mem. Talasso, Italiano*, No. 68, 255 pp., 26 pl.
- PEARSE, A. S. 1947. Parasitic copepods from Beaufort, North Carolina. *Journ. Eilsha Mitchell Sci. Soc.*, 63 : 1-16.
- . 1948. A second report on parasitic copepods collected at Beaufort, N.C. *Ibid.*, 64 : 127-31.
- . 1951. Parasitic crustacea from Bimini, Bahamas. *Proc. U.S. Nat. Mus.*, 101 : 341-372, 11 figs.
- . 1952. Parasitic crustacea from the Texas coast. *Publ. Inst. Mar. Sci. Univ. Texas*, 2(2) : 5-42.
- . 1952. Parasitic crustaceans from Alligator Harbour, Florida. *Quart. J. Florida Acad. Sci.*, 15 (4) : 187-243.
- PESTA, O. 1934. Krebstier oder Crustacea I. Ruderfusser oder Copepoda (4. Monstrilloida, 5. Notodelphyoida, 6. Caligoida, 7. Lernaecoida). *Tierw. Deutschlands*, Tl. 29(4) + 68 pp.
- PRIOL, E. P. 1944. Observations sur les germons et les thons rouges captures par les pecheurs bretons. *Rev. Trav. Off. Peches marit.*, 13 : 387-439.
- RANGNEKAR, M. P. 1953. *Anuretes branchialis* sp. nov. a copepod parasitic on the fish *Thynnus pelamys*. *J. Zool. Soc. India*, 5 : 239-42.
- . 1955. *Caligus bombayensis* sp. nov., a new copepod parasitic on *Mugil cephalus* Linn. *J. Univ. Bombay*, 24(3) : 55-59.
- . 1955. *Mappates plataxus*, gen. et sp. nov., a copepod parasitic on the fish *Platax teira* (Forsk.). *Rec. Indian Mus.*, 53(3 & 4) : 303-308.
- . 1957. *Caligus dasyticus* sp. nov., and *Caligus dussumieri* (Copepoda) parasitic on Bombay Fishes. *J. Univ. Bombay*, 25(5) : 16-22.

- RAO, T. S. S. 1951. Occurrence of *Lernaeenicus* sp. on *Scomber scomber*, Lawson's Bay, Waltair. *Curr. Sci.*, 21(4) : 103-104.
- . 1951. On a new caligid parasite *Glutopotes zeugopteri* sp. nov., from *Xiphias zeugopteri*, Lawson's Bay, Waltair. *Proc. Indian Acad. Sci.*, 34B(5) : 248-55.
- RATHBUN, M. J. 1905. Fauna of New England. 5. List of the crustacea. *Occ. Papers Boston Soc. Nat. Hist.*, 7 : 1-117.
- RATHBUN, R. 1884. Annotated list of the described list of parasitic copepods (Sphonostoma) from American waters contained in the U.S. National Museum. *Proc. U.S. Nat. Must.* 7: 483-92.
- . 1886. Descriptions of parasitic copepods belonging to the genera *Pandarus* and *Chondracanthus*. *Ibid.*, 10 : 310-24.
- . 1887. Descriptions of new species of parasitic copepods belonging to the genera *Trebius*, *Perissopus*, and *Lernanthropus*. *Ibid.*, 10 : 559-71.
- RATHKE, H. 1843. Beitrag zur Fauna Norwegens. *Nova Acta Acad. Leopold-Carolin.* 20 : 264 pp.
- RICHIARDI, S. 1880. Catalogo sistematico dei crostacei che vivono sul corpo degli animali aquatici. *Catalogo Sez. Ital. Esposiz. Internaz. di Pesca. Berlino. 1880-Firenze-anche in Pisa tip. Vannucchi 1880* (8 pp.).
- . 1882. Descrizione di una nuova specie del genere *Chondracanthus*. *Zool. Anz.*, 5 : 504-505,
- RONALD, K. 1959. A checklist of the Metazoan parasites of the Heterostomata. *Contrib. No. 87. Dept. Fisher. Quebec, Canada*, 152 pp. xx.
- SCOTT, A. 1906. Faunistic notes. *Trans. Biol. Soc. Liverpool*, 20 : 191-201.
- SCOTT, T. 1900. On copepods living in the nostrils of fishes. *Ann. Scott. Nat. Hist.*, 153-155 (July, 1900).
- . 1900. Notes on some crustacean parasites of fishes. *18th Ann. Rept. Fishery Board Scotland*, 144-188.
- . 1901. Notes on some parasites of fishes. *19th Ann. Rept. Fishery Board, Scotland*, 120-151.
- . 1914. Remarks on some Copepoda from the Falkland Islands collected by Mr. Rupert Vallentin, F.L.S. *Ann. Mag. Nat. Hist.*, ser. 8, 13 : 369-79.
- SCOTT, T., AND SCOTT, A. 1913. *British Parasitic Copepoda*, 2 Vols., 254 pp., and 72 pls.
- SHIINO, S. M. 1952. Copepods parasitic on Japanese fishes. 1. On the species of *Caligus* and *Lepeophtheirus*, *Rep. Fac. Fish. Pref. Univ. Mie*, 1 : 79-112.
- . 1954. Copepods parasitic on Japanese fishes. 4. The family Euryphoridae. *Ibid.*, 1: 273-290.
- . 1954. Copepods parasitic on Japanese fishes. 6. Two species of the family Cecropidae. *Ibid.*, 1: 333-45.
- . 1954. Copepods parasitic on Japanese fishes. 3. On two new species of *Anuretes*. *Ibid.*, 1 : 263-272.
- . 1954. Note on *Caligus quadratus* n. sp., a copepod parasitic on the fish, *Neothunnus macropterus* (T. & S.). *Bull. Jap. Soc. Sci. Fish.*, 20 : 26-29.
- . 1954. On maleforms of the copepod *Caligus katuwo* Yamaguti parasitic on the Japanese bonito, *Euthynnus pelamys*. *Zool. Mag. Tokyo*, 63 : 246-49.
- . 1955. *Aligaligus tripartitus* gen. et sp. nov., Caligoid copepod found on the gills of *Sarda orientalis*. (T. & S.). *Pacific Sci.*, 9 : 56-61.
- . 1955. Copepods parasitic on Japanese fishes. 8. Family Anthosomidae. *Rep. Fac. Fish. Pref. Univ. Mie.*, 2 : 52-69.
- . 1955. Copepods parasitic on Japanese fishes. 9. Family Chondracanthidae, subfamily Chondracanthinae. *Ibid.*, 2 : 70-111.
- . 1956. Copepods parasitic on Japanese fishes 10. The Redescription of three species of *Caligus*. *Ibid.*, 2 : 233-41.

- SHIINO, S. M. 1956. Copepods parasitic on Japanese fishes 12. Family Lernaeopodidae. *Ibid.*, 2 : 269-311.
- . 1957. Copepods parasitic on Japanese fishes 13. Parasitic copepods collected off Kesennuma, Miyagi Prefecture. *Ibid.*, 2 : 359-75.
- . 1958. Copepods parasitic on Japanese fishes. 17. Lernaeidae. *Ibid.*, 3 : 75-100.
- . 1958. Parasitic Copepods of fishes collected in the Indian Ocean. *Ann. Rept. Pref. Univ. Mie., Sec. 2, Nat. Sci.*, 2 : 98-103.
- . 1959a. Revision der auf Goldmakrele, *Coryphaena hippurus* L., Schmarotzenden Caligidarten. *Ibid.*, 3 : 1-34.
- . 1959b. Sammlung der parasitischen Copepoden in der Praefekturuniversitat von Mie. *Rep. Fac. Fish. Pref. Univ. Mie.*, 3 : 334-74.
- . 1959d. Neuer Artname fur japanische Exemplare von *Caligus bonito*. *Bull. Biogeog. Soc. Japan*, 20(11) : 51-57.
- . 1959e. Ostpazifische Parasitierende Copepoden. *Rep. Fac. Fish. Pref. Univ. Mie.*, 3 : 267-333.
- . 1959f. On a new species of *Caligus* (Copepoda Parasitica) from the coast of California. *Pacific Sci.* 13 : 351-56.
- . 1960. Copepods parasitic on the fishes collected on the coast of Province Shima, Japan. *Rep. Fac. Fish. Pref. Univ. Mie.*, 3 : 471-500.
- . 1960. Parasitic copepods of fishes from Eastern Pacific. *Ibid.*, 3 : 527-41.
- SHISHIDO, I. 1898. Parasitic copepods, Lernanthropus (In Japanese). *Zool. Mag.*, 10 : 82-87 ; 120-125 ; 148-151 ; 215-218 ; 254-256 ; and 337-340.
- . 1898. On the fish lice of *Mola mola*. *Zool. Mag.*, 10 : 90-91.
- STEBBING, T. R. R. 1900. South African Crustacea. Pt. 1. Cape of Good Hope, Dept. of Agriculture, Marine Invest. S. Africa.
- . 1900. On the crustacea brought by Dr. Willey from the South Seas in Willey's Zoological Results, Pt. 2 (Cambridge Univ. Press, Dec. 1900).
- . 1910. General catalogue of South African Crustacea (Part I of S. A. Crustacea for marine investigations in S. Africa). *Ann. S. African Mus.*, 6(14) : 281-593.
- STEENSTRUP, J. J. S., 1862. *Philichthys xiphae* en ny snylter hos Svaerdfisken. *Overs. Kongel. Danske Vidensk. Selsk. Forhand.* 1861, 295-305.
- AND C. F. LUTKEN. 1862. Bidrag i Kundskab om det abne Havs Snyltekrebs og Lernaer samt om nogle andre nye eller kidtil kul ufuldstaendigt Kjendte parasitisk Copepoder. *Vid. Selsk. Skrift.*, 5 Raekke, *Naturw.-mauh. Afh.*, Bd. 5 : 345-432.
- SUMNER, E. B., OSBURN, R. C., AND COLE, L. J. 1913. A biological summary of the waters of Woods Hole and vicinity. Part 2, Section 3. A catalogue of the marine fauna. *Bull. Bur. Fish.*, 33(2) : 549-794.
- THOMPSON, G. M. 1889. Parasitic copepods of New Zealand. *Trans. New Zealand Inst.*, 22 : 353-75.
- THOMPSON, I. C., AND SCOTT, A. 1900. Supplementary Report 7. On the Copepoda. Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Mannar. Pt. 1 : 227-307. Published by Royal Society.
- THOMPSON, W. 1847. Additions to the fauna of Ireland. *Ann. Mag. Nat. Hist.*, ser. 1, 20 : 248.
- TIMM, R. 1894. Fauna der Sudostlichen und ostlichen Nordsee. 4. Copepoden und Cladoceran. *Wiss. Meer. Konm. Unters. Deutsch. mere keil. Biol.-Anst. Helgoland. N.F.* 1 : 363-402.
- TURNER, W., and H. S. Wilson, 1862. Observations on Parasitic Crustacea *Chondracanthus lophii* and *Lernaeopoda dalmanni*. *Trans. Roy. Soc. Edinburgh*, 23 (3) : 67-87, pt. 4.
- VALLE, A. 1880. Crostacei parassiti dei pesci del mare Adriatico. *Boll. Soc. Adriat. sci. Nat.*, 6 : 55-90.
- . 1882. Aggiunte ai Crostacei parassiti deipesci del mare Adriatico. *Ibid.*, 7 : 3.

- VERRILL, A. E., and Smith S. I. 1873 Report upon the invertebrate animals of Vineyard Sound and adjacent waters, with an account of the physical features of the region. *Rept. Comm. Fish and Fisheries*, 1871-1872; 295-778.
- VOGT, C. 1877. Researches Cotieres Arch. *Zool. Exp. Gen.*, 6: 385-456.
- WHITE, A. 1850. List of specimens of British animals in the collection of the British Museum. Pt. 4. Crustacea. London, 117-32.
- WILSON, C. B. 1905. North American Parasitic copepods belonging to the family Caligidae. Part 1. The Caliginae. *Proc. U.S. Nat. Mus.*, 28: 479-672.
- . 1906. Supplementary report XXXIV. On some parasitic copepoda. Rept. to the Govt. of Ceylon on the Pearl Oyster fisheries of the Gulf of Mannar. Part. 5: 189-210. (Published by the Royal Society.)
- . 1907a. North American parasitic copepods belonging to the family Caligidae. Part 1. The Trebinae, and Euryphorinae. *Proc. U.S. Nat. Mus.*, 31: 669-720.
- . 1907b. North American parasitic copepods belonging to the family Caligidae. Parts 3 & 4, A revision of the Pandarinae and the Cecropinae. *Ibid.*, 33: 323-490.
- . 1908. North American parasitic copepods: A list of those found upon the fishes of the Pacific Coast, with descriptions of new genera and species. *Ibid.*, 35: 431-481.
- . 1911a. North American parasitic copepods. Part 9. The Lernaeopodidae. *Ibid.*, 39: 189-226.
- . 1911b. North American parasitic copepods. Descriptions of new genera and species. *Ibid.*, 39: 625-634.
- . 1912. Descriptions of new species of parasitic copepods in the collections of the United States National Museum. *Ibid.*, 42: 233-43.
- . 1913. Crustacean parasites of West Indian Fishes and land crabs, with descriptions of new genera and species. *Ibid.*, 44: 189-277.
- . 1915. North American parasitic copepods belonging to the family Lernaeopodidae, with a revision of the entire family. *Ibid.*, 47: 565-729.
- . 1917. North American copepods belonging to the Lernaeidae, with a revision of the entire family. *Ibid.*, 53: 1-150.
- . 1922a. North American parasitic copepods belonging to the family Dichelesthiidae. *Ibid.*, 60: 1-100.
- . 1922b. Parasitic copepods of Japan including five new species. *Ark. f. Zool.*, 14(10): 1-17.
- . 1923. A new genus and species of parasitic copepod from Lower California. *Amer. Mus. Novit.*, 81: 1-4.
- . 1932. The copepods of the Woods Hole Region, Massachusetts. *U.S. Nat. Mus. Bull.* 158: 1-635.
- . 1935a. Parasitic copepods from the Dry Tortugas. *Pap. Tortugas Lab.*, 29: 327-47.
- . 1935b. Parasitic copepods from the Pacific coast. *Amer. Midland Nat.*, 16: 776-787.
- . 1937a. Some parasitic copepods from Panama Bay. *J. Washin. Acad. Sci.*, 27: 423-431.
- . 1937b. Parasitic copepods taken during the Third Hancock Expedition to the Galapagos Island. *Rept. Allan Hancock Pacif. Exped.*, 2(4): 23-30.
- . 1944. Parasitic copepods in the U.S. National Museum. *Proc. U.S. Nat. Mus.*, 94: 529-582.
- . 1950. Copepods gathered by the U.S. Fisheries Steamer ALBATROSS from 1887-1909 chiefly in the Pacific Ocean in Contribution to the biology of the Philippine Archipelago and adjacent regions. *Bull. U.S. Nat. Mus.*, 100: 141-441.
- WRIGHT, E. P. 1870. On a new species of the genus *Pennella*. *Ann. Mag. Nat. Hist.*, ser. 4, Vol. 5: 45.
- YAMAGUTI, S. 1936. Parasitic copepods from fishes of Japan. 2. Caligoida, 1: 1-22.
- . 1939a. Parasitic copepods from fishes of Japan. 6. Lernaeopodida, 1. Vol. Jubil. Prof. S. Yoshida, 2: 529-578. (Osaka).

- YAMAGUTI, S. 1939b. Parasitic copepods of fishes from Japan. 4. Cyclopoida, II. *Ibid.*, 2 : 392-415.
- . 1939c. Parasitic copepods of fishes from Japan. 5. Caligoida III. *Ibid.*, 2 : 443-487.
- . 1953. Parasitic copepods from fishes of Japan. 7. Cycilopoda III. and Caligoida, III. *Publ. Seto. Mar. Biol. Lab.*, 3(2) : 221-231.
- . 1954. Parasitic copepods from fishes of Celebes and Borneo. *Ibid.*, 3(3) : 375-398.
- , AND YAMASU, T. 1959. Parasitic copepods from fishes of Japan with descriptions of 26 new species and remarks on two known species. *Biol. J. Okayama Univ.* 5 : 89-165.
- YU, S. C. 1934. Studies on parasitic copepods of China belonging to the family Chondracanthidae. *Bull. Fan. Mem. Inst. Biol.*, 4 : 1-16.

ADDENDUM

Since the holding of the Symposium in January 1962, several contributions on parasitic copepods of fishes have come out and a few deal with descriptions of new species of copepods parasitic on scombroid fishes. In order to make this work upto date and useful, these additions, along with a few species not referred to in the earlier account and some species on which more information has now become available are included in the following list. As would be seen from the separate 'Host-Parasite list' given at the end, these additions are recorded from nineteen scombroid host species.

Suborder CYCLOPOIDA

Family : BOMOLOCHIDAE

Genus *Bomolochus* Nordmann, 1832

**Bomolochus aculeatus* Pillai, 1962

Suborder CALIGOIDA

Family : CALIGIDAE

Genus *Caligus* Müller, 1785

- **Caligus affinis* Kurian, 1961.
- Caligus alalongae* Kroyer, 1863.
- **Caligus alolaris* Heegaard, 1962.
- **Caligus amblygenitalis* Pillai, 1961.
- **Caligus auxisi* Pillai, 1962.
- **Caligus brevisoris* Shen, 1957.
- Caligus coryphaenae* Steenstrup and Lutken, 1961.
- **Caligus euthynnus* Kurian, 1961.
- **Caligus kanagurta* Pillai, 1961.
- Caligus kuroshio* Shiino, 1959.
- **Caligus maculatus* Heegaard, 1962.
- **Caligus microdontus* Heegaard, 1964 (Nom. nov. for *C. dentatus* Heegaard, 1962, Preoccupied).
- **Caligus obovatus* Heegaard, 1962.
- **Caligus proboscidaetus* Heegaard, 1962.
- **Caligus quinqueabdominalis* Heegaard, 1962.
- Caligus rapax* Milne-Edwards, 1840.
- **Caligus thynni* Pillai, 1962.

Family : EURYPHORIDAE

Genus *Caligulus* Heegaard, 1962

- **Caligulus longispinosus* Heegaard, 1962.

An * indicates species not dealt with earlier.

as shown in figure xxxvii ; fifth leg two segmented, first segment short, second with four spines, ventral surface spiny ; sixth leg represented by a bunch of six simple setae ; anal laminae ventrally spiny, with one long and four short setae. Total length 1.3 mm.

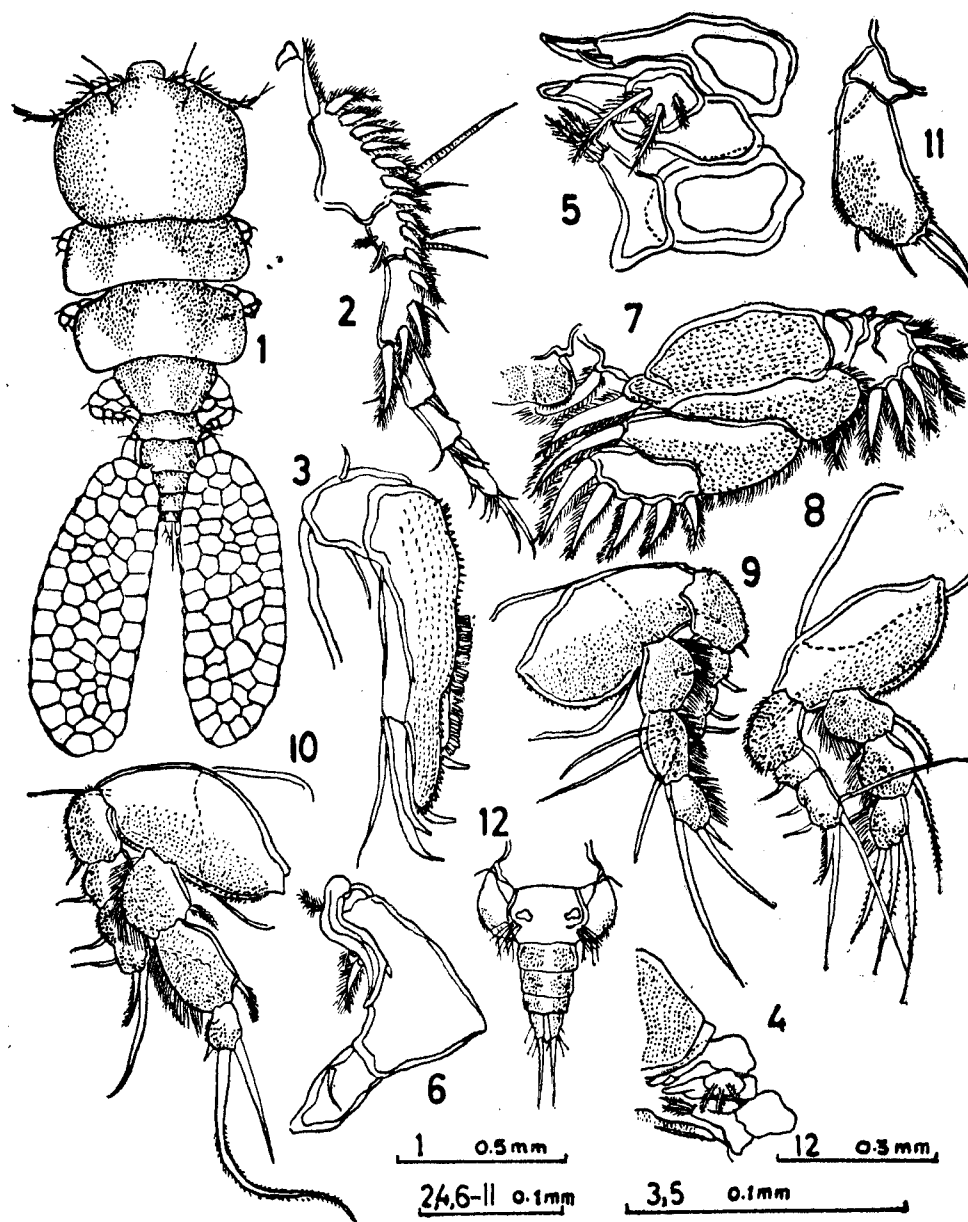


Figure 37. 1-12. *Bomolochus aculeatus* Pillai. Female: 1. Dorsal view; 2. antennule; 3. antenna; 4. mouth parts, ventral view; 5. mandible, maxilla and first maxilliped; 6. second maxilliped; 7. first leg; 8. second leg; 9. third leg; 10. fourth leg; 11. fifth leg; 12. genital segment and abdomen, ventral view (After Pillai, 1962).

Male : Unknown.

Scombroid host : *Rastrelliger kanagurta* (Cuvier).

Locality : Trivandrum, S.W. Coast of India.

Non-scombroid hosts : None.

Location : Inner surface of opercle of host.

Reference : Pillai (1962).

Suborder CALIGOIDA

Family : CALIGIDAE

Genus *Caligus* Müller, 1785

Caligus affinis Kurian, 1961

(Figure 44 : 16-24)

Description : *Female*.—Carapace ovate, about 1/7th longer than broad ; frontal plate, broad, slightly arched anteriorly ; lunules large and almost circular ; posterior median lobe of carapace surpasses posterior end of lateral lobes slightly and is about 0.5 width of carapace ; fourth thoracic segment wider than long, confluent with genital segment ; latter hexagonal, about as wide as long and slightly more than half length of carapace (distinctly less than half length of carapace in figure) ; abdomen narrow, single jointed, about twice as long as broad (given as about 3 times as long as broad by Kurian, but shown in figure as hardly twice as long as broad) and indistinctly demarcated from genital segment ; anal laminae short, slightly longer than broad, each with five plumose setae. Antennule two segmented, basal segment much broader than terminal, but both of equal length ; antenna with terminal claw long and tip curved at right angles ; maxillule in the form of a long and pointed spine slightly curved inwards ; maxilla reduced to small blunt lobe ; claw of second maxillipede narrow ; sternal furca slender and directed obliquely outwards ; first leg three-jointed with three ciliated spines at free end and three long plumose setae on inner border of third joint ; second and third legs normal [Kurian's text-fig. 42 (p. 76) labelled as 'second peraeopod' is in fact the third leg]. Fourth leg three-jointed, first joint large, slightly longer than second and third joints combined ; long plumose seta present on distal outer margin of first and second joints ; third joint with four broad or winged spines on outer margin distally ; rudimentary fifth and sixth legs represented by one and two plumose setae respectively. Total length 3.6 mm.

Male.—Unknown.

Scombroid host : *Euthynus affinis* (Cantor) [= *Euthynnus a. affinis* (Cantor)].

Locality : S. W. Coast of India (Kerala).

Non-scombroid hosts : None.

Location : External surface of body.

Remarks : The species name *Caligus affinis* Kurian, 1961 is preoccupied by *Caligus affinis* Heller (1866. Carcinologische Beiträge zur Fauna des adriatischen Meers. *Verhandl. k. k. zool.-botan. Gesellschaft in Wien*, 16 : 723-60) and as such will need a new name. The author's attention is being drawn to this and it is hoped that when a new name is proposed he will also give a redescription of the species if possible, to clarify several of the discrepancies between his description of the species and the drawings.

Caligus alalongae Kroyer

The following information clarifying the status of some of the species mistakenly placed under this species appears pertinent.

We have already drawn attention to Shiino's remarks that Kirthsinghe's (1956 : *Parasitology*, 44 : 14-21) *C. alalongae* does not seem to be conspecific with *C. alalongae* Kroyer (1863). Pillai (1961) has given reasons for considering *C. alalongae* Kirtisinghe (1937) (*nec* Kroyer) and *C. constrictus* Wilson (1937) and Shiino (1959) (*nec* Heller, 1865) as being identical and constituting a distinct species for which he proposed the new name *C. confuses*. Pillai has also drawn attention to the considerable resemblance of *Midias carangis* Ranghekar (1956 : *J. Univ. Bombay*, 24 (n.s.), 5 : 42-65) to *C. constrictus* with the comment that '*Midias* is an illdefined genus.'

***Caligus alveolaris* Heegaard, 1962**

(Figure 39 : 1-9)

Description : Female.—Carapace quadrangular, longer than wide ; frontal plates wide and not emarginate at centre ; lunules large and slightly project beyond frontal plate ; lateral lobes of carapace narrow, slightly curved inward ; median lobe broad about two-thirds width of carapace and extending to slightly behind level of lateral lobes ; free thoracic segment much broader than long, width about two-thirds that of genital segment ; latter square with two posterior lobes ; two segmented abdomen, about as long as genital segment and with terminal segment hollowed out postero-laterally to accommodate small lateral anal laminae which do not reach beyond the tip of abdomen ; each anal lamina with three plumose setae posteriorly and a short one laterally ; egg strings short, a little longer than abdomen and egg cases about half width of abdomen. Second maxilliped three-jointed with a slender claw with an accessory spine and median side of proximal joint with a short hooked spine ; rudimentary fifth pair of legs seen as knobs at posterior end of genital segment bearing short setae ; other details of mouth parts and appendages as shown in figure. Total length 5.5 mm. ; length of carapace 2.5 mm. ; width 2.0 mm.

Male.—Carapace about same size as in female ; genital segment much smaller and is broader than long ; two-jointed abdomen with proximal joint shorter ; antenna stronger than in female with stronger accessory spine, but distal joints hook-shaped. Maxilla more pointed, second maxilliped stronger and stouter than in female ; vestigial remains of both fifth and sixth legs seen on genital segment ; branches of furca in male more open. Length of genital segment 0.7 mm. ; width 0.9 mm.

Scombroid hosts : *Euthynnus alletteratus* (= *Euthynnus affinis yaito* Kishinouye).

Locality : Howick Island, North Queensland, Australia.

Non-scombroid hosts : None.

Location : 'from skin' (External surface of body).

Remarks : Heegaard (1962) remarks that *C. alveolaris* resembles very much the young of *C. coryphaenae* (Heegaard, 1948), but 'is smaller and with accessory spines on the second antenna and second maxilliped. It differs further in the shape of the spines of the first, second and fourth legs.'

***Caligus amblygenitalis* Pillai, 1961**

(Figure 40 : 36-45)

Description : Female.—Carapace oblong, longer than broad, and slightly narrowed towards front ; frontal plates as deep as lunules, latter circular and prominent ; postero-lateral lobes of carapace not extending to level of posterior end of median lobe, latter four times as broad as lateral lobe ; transverse groove on dorsum of carapace situated more or less at its mid length ; short fourth thoracic segment not clearly demarcated from genital segment which is shorter than carapace length, but narrower with nearly parallel sides and with a pair of postero-lateral rounded lobes ;

abdomen single segmented and more or less rectangular ; and laminae longer than broad, being rectangular. Antenna robust with third segment bent at right angles at middle ; maxillule long and blunt with three elongate setae ; maxilla more or less triangular with a narrow apical border and a palp with three short spines. Mouth parts and appendages as shown in figure. Total length 3.2 mm.

Male.—Unknown.

Scombroid host : *Euthynnus affinis* (Cantor) [= *E. a. affinis* (Cantor)].

Locality : Vizhingam, S.W. Coast of India.

Non-scombroid hosts : None.

Location : From outer surface of body.

References : Pillai (1961).

Remarks : The species is described from a single female example. According to Pillai (1961) 'Just behind and slightly internal to the second maxilla there is a pair of short apically rounded chitinous processes resembling the apical part of the maxillae, which may be an abnormality.' In the enlargement of genital segment this species is said to resemble *C. glandifer* Shiino (1954) and *C. klawei* Shiino (1959), but in the shape of the segment and row of teeth on the second claw of the endopod of the second leg it differs from them.

***Caligus auxisi* Pillai, 1963**

(Figure 38 : 1-20)

Description : *Female*.—Carapace orbicular, frontal plates well defined, lunules large; postero-median lobe of carapace broad, about half width of carapace and reaching beyond tip of lateral lobes ; fourth thoracic segment broader than long ; enlarged genital segment broadly triangular with a constricted 'neck' and broadest posteriorly, but width of segment almost equaling its length ; single segmented abdomen long with parallel sides ; anal laminae longer than broad, each with three long and two short setae ; sternal fork with narrow base and long and stout rami which are apically subtruncate with broad wings ; fourth leg three segmented, basal segment longest ; lower distal border of second segment with small sharp teeth ; claws of distal segment progressively increasing in length to apical claw. Other mouth parts and appendages as shown in figure. Total length 3.8 mm.

Male.—Carapace orbicular, lateral lobes broader and postero-median lobe slightly projecting behind former ; genital segment pyriform ; two segmented abdomen with distal segment longer ; second segment of antenna with a rough raised distal pad, third segment short and claw-like ; base of latter with a stout accessory claw and a spine making it trifid ; inner border of second maxilliped raised into four low projections. Total length 2.7 mm.

Scombroid host : *Auxis thazard* (Lacépède).

Locality : Trivandrum, S.W. Coast of India.

Non-scombroid hosts : None.

Location : From inner surface of opercle of host.

Remarks : Description is based on three females and two males. According to Pillai (1963) this species closely resembles *C. bonito* Wilson (1905), *C. kuroshio* Shiino (1959), and *C. indicus* Pillai (1961), especially in the structure of the legs, the maxillule, and the antenna of the female, but the shape of the abdomen and the sternal fork differentiates it from the three species.

Caligus brevisoris Shen, 1957

(Figure 40 : 1-18)

Pillai (1961) records this species from the following scombroid host :

Scombroid host : *Indocybium guttatum* (Bloch and Schneider) [= *Scomberomorus guttatus* *guttatus* (Bloch and Schneider)]

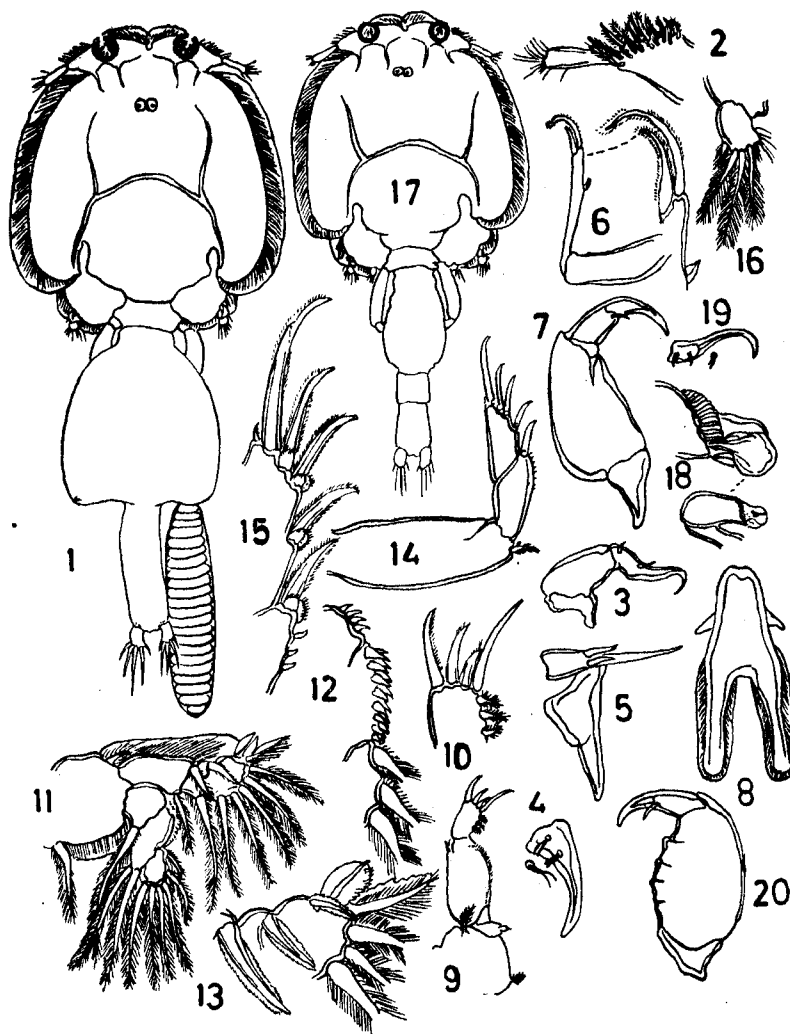


Figure 38. 1-20. *Caligus auxisi* Pillai, 1962c. Female (1-16): 1. dorsal view; 2. antennule; 3. antenna; 4. maxillule; 5. maxilla; 6. first maxilliped; 7. second maxilliped; 8. sternal fork; 9. first leg; 10. same, tip of exopod; 11. second leg; 12. same, endopod; 13. same, exopod; 14. fourth leg; 15. same, tip enlarged; 16. anal lamina. Male (17-20): 17. dorsal view; 18. antenna; 19. maxillule; 20. second maxilliped (After Pillai, 1962c).

Locality : Vizhingam, S.W. Coast of India.

Non-scombroid hosts : ? (Shen's work has not been consulted in original by us).

Location : Inner surface of opercle of host.

Reference : Shen (1957) ; and Pillai (1961).

Remarks : Pillai (1961) has given a redescription of this species based on several specimens (of males and females) with the remarks that his specimens differ slightly from the description of the species given by Shen (1957) 'in the details of the appendages and in the shape of the genital segment.' Unlike Shen's description of the claws arming the fourth leg which are said to be neither pubescent nor possessing a lappet at the base of each, but having only a membranous border, Pillai's specimens show that all spines are bordered with wings and each spine has a long row of spinules at its base. The spinules are carried on long prolongations at the base of the third and fourth claws.

Total length of female 6.0 mm. ; of male 4.0 mm.

***Caligus coryphaenae* Steenstrup and Lutken, 1861**

This species has already been described and figured (p. xxxxx fig. III : 1-14). It may be mentioned here that Kurian (1961) records this species from two scombroid hosts for the first time from Indian coastal waters.

Scombroid hosts : (1) *Euthynnus affinis* (Cantor) [= *Euthynnus affinis affinis* (Cantor)]
(2) *Katsuwonus pelamis* (Linnaeus).

Locality : 1 & 2 South west coast of India (Kerala).

Non-scombroid hosts : None mentioned by Kurian (1961). But for list see p. 992.

Location : External parasite on body.

Remarks : We would refer to our earlier discussion under *C. coryphaenae* (p. 884) wherein following Shiino (1959a) we have considered *C. tesserifer* Shiino as a synonym of *C. coryphaenae* Steenstrup and Lutken. However, Kurian (1961) recognises *C. tesserifer* as a valid species and mainly distinguishes it from *C. coryphaenae* by its reduced number of abdominal segments (2 versus 4 in *C. coryphaenae*). According to him, 'Shiino observes that in alcohol-preserved specimens the segmentation of the abdomen disappears and Heegaard maintains that the number of abdominal segments may increase from three to four even after the female reaches sexual maturity. However, in all the alcohol-preserved specimens I have examined, even though the segmentation is somewhat indistinct, it becomes clear when stained. Contrary to Heegaard's (*op. cit.*—1949. *Vidensk. Medd. fra. Dansk. Naturh. Foren.*, 3 : 235-245) observation, it is seen that segmentation is constant in both mature and juvenile specimens.'

Kurian (1961) is also of the opinion that *C. aliuncus* Wilson could be distinct from *C. coryphaenae* '... especially in view of the fact that the carapace in *C. aliuncus* is less than half the length of the entire animal while in *C. coryphaenae* it is more than half.' However, we find that in his figure of *C. coryphaenae* (Kurian, 1961, fig. 16, p. 68) the carapace is shown as being shorter than half total length !

Kurian (1961) has given a detailed comparison of *C. euthynnus* Kurian, *C. tesserifer* Shiino, and *C. coryphaenae* Steenstrup and Lutken.

***Caligus euthynnus* Kurian, 1961¹**

(Figure 44 : 1-15)

Description : *Female*.—Carapace ovate, not half as long as body, but longer than wide ; posterior median lobe broad, more than half diameter of carapace and extending behind lateral lobes and provided with a minute spine at each outer angle ; free thoracic segment twice as wide

¹ Since this species is named after the host genus *Euthynnus*, the specific name *C. euthynnus* Kurian is emended to *C. euthynnus* here.

as long (shown in figure as 2.5 times as wide as long) and one-third width of carapace (shown in figure as still wider); genital segment partly demarcated from free thoracic segment by lateral notches; segment about as long as wide being broader posteriorly ending in two lobular projections; abdomen two-jointed, about as long as genital segment and indistinctly demarcated from each other and from genital segment; second abdominal segment about two-thirds as long as first; egg strings slightly longer than total length which is about 6.2 mm. Antennule two-jointed, basal stout, terminal short and slender, about half as long as basal (shown in figure as being of almost equal length as basal segment); maxillule indistinct; mouth-cone long; mandible with 12 teeth at curved distal end; first maxilliped long, two-jointed, basal joint stout and short, distal joint with an acuminate lamina and two curved serrated setae at end; second maxilliped with basal joint bearing two tubercles, one near its articulation and second near middle of its inner edge, and with a strong terminal claw; arms of sternal furca parallel, and distal ends rounded; basal hook of exopodite of third leg curved and stout; fourth leg well developed, four-jointed, first joint thick, slightly longer than rest; first, second and third joints, each with one spine at distal end; last joint with three long and one small spine at apex; fifth and sixth legs rudimentary, but visible dorsally; anal laminae (from figure) slightly broader than long.

Male.—Carapace shaped as in female, but length more than half total length; genital segment distinctly broader than long, but narrower than posteromedian lobe of carapace; exopod of fifth leg in form of tubercular projection with long plumose seta and placed postero-laterally on genital segment; exopod of sixth leg of similar structure, but smaller; abdomen two-jointed, as long as genital segment; first abdominal segment one third (shown in figure as half) as long as second segment; anal laminae much broader than long (from figure).

Scombroid host: *Euthynnus affinis* (Cantor) [= *Euthynnus a. affinis* (Cantor)]

Locality: S.W. Coast of India (Kerala).

Non-scombroid host: None.

Location: External surface of body.

***Caligus kanagurta* Pillai, 1961**

(Figure 40: 19-35)

Description: Female.—Carapace about as long as wide, being broader posteriorly; lunules small, frontal plates narrow; posterolateral lobes short, each one-third as wide as posteriorly rounded median lobe which extends much backwards; transverse groove on dorsum of carapace falling slightly in posterior half of carapace length; genital segment large and more or less of same size as carapace, but reniform in shape with posterior ends produced into bluntly rounded lobes; two segmented abdomen with anterior segment swollen, large and elliptical and second segment short and more or less rectangular; and laminae longer than broad being oblong.

Distal segment of antennule carrying longer setae; antenna slender and strongly falcate with two spines; maxillule with a broad base and a short rounded process; rami of sternal fork stout and externally winged; distal exopod segment of first leg with four subsimilar claws and three setae; first three claws of exopod of second leg simple; first seta of third segment winged on both sides and second on one side; mouth parts and other appendages as shown in accompanying figure. Total length 4.2 mm.

Male.—Unknown.

Scombroid host: *Rastrelliger kanagurta* (Cuvier).

Locality: Trivandrum, south west coast of India.

Non-scombroid hosts: None.

Location : From inner side of opercle.

Reference : Pillai (1961).

Remarks : The fourth leg is characteristic for this species and has been described as 'four segmented, first segment as long as the rest of the limb, second and third segments with one each and fourth with three winged prominently pectinate large claws, the spiny lobe at the base of the claws produced into long slanting processes, each carrying a comb of long hairs.' This considerably reduced distal three segments of the fourth leg as a result of which the setae are closely placed and the elongate claws with basal processes is remotely seen in *C. multispinosus* Shen. The reniform shape of the genital segment is also characteristic for *C. kanagurta*.

***Caligus kuroshio* Shiino, 1959**

(Figure 42 : 12-16)

Pillai (1963) records this species from the undermentioned scombroid fish.

Scombroid host : *Euthynnus affinis* (Cantor) [= *Euthynnus affinis affinis* (Cantor)]

Locality : Trivandrum, S.W. Coast of India.

Non-scombroid hosts : None.

Location : Gill arches.

Remarks : Pillai (1963) has only tentatively identified his material as *C. kuroshio*, as they show the following differences from Shiino's description of the species. The genital segment is broadest posteriorly and not in the middle as in *C. kuroshio*. Secondly, the sternal fork has long apically narrowed slender rami, while in *C. kuroshio* the rami are short, parallel sided and apically subtruncate.

According to Pillai (1963) in the above characters his specimens also differ from *C. bonito* Wilson (1905) and '... there is some difficulty in placing the present material under either of the two species (meaning *C. kuroshio* and *C. bonito*). Probably the description of *C. bonito* by Wilson is incomplete. Pending a detailed study of *C. bonito* the present material is identified as *C. kuroshio*.'

***Caligus maculatus* Heegaard, 1962**

(Figure 39 : 10-18)

Description : *Female*.—Carapace elliptical, slightly longer than broad ; frontal plates distinct with anterior margin emarginate at centre ; lunules large and semicircular ; lateral lobes of carapace narrow and short ; median lobe broad, about two-thirds width of carapace and extending well behind posterior tip of lateral lobes ; large genital segment more or less quadrilateral with rounded margins anteriorly and postero-laterally produced into two quadrangular lobes ; abdomen with two segments of nearly equal size ; (in young female and male, the first abdominal segment is only half length of second segment and towards free thoracic segment genital segment has a short transversely wrinkled neck—fig. XXXIX, 18) ; anal laminae small, each terminated by one short and three long plumose setae ; egg-sacs conspicuously long. Furca open and cut wide beyond centre with branches about twice as long as base ; latter much swollen, with two processes one at each side of peduncle and coalesced with it ; fourth pair of swimming legs three-jointed, basal joint a little longer than combined length of two distal joints ; second joint tipped with a claw, the longest for the leg ; terminal joint tipped with three claws, the distal one being largest while the other two are equal or subequal ; fifth claw placed at lateral margin of terminal joint ; fifth legs wanting in female ; other mouth parts and appendages as in figure. Total length 6.0 mm. ; length of carapace 3.0 mm. ; width 2.25 mm. ; length of genital segment 1.5 mm. ; length of abdomen 1.2 mm.

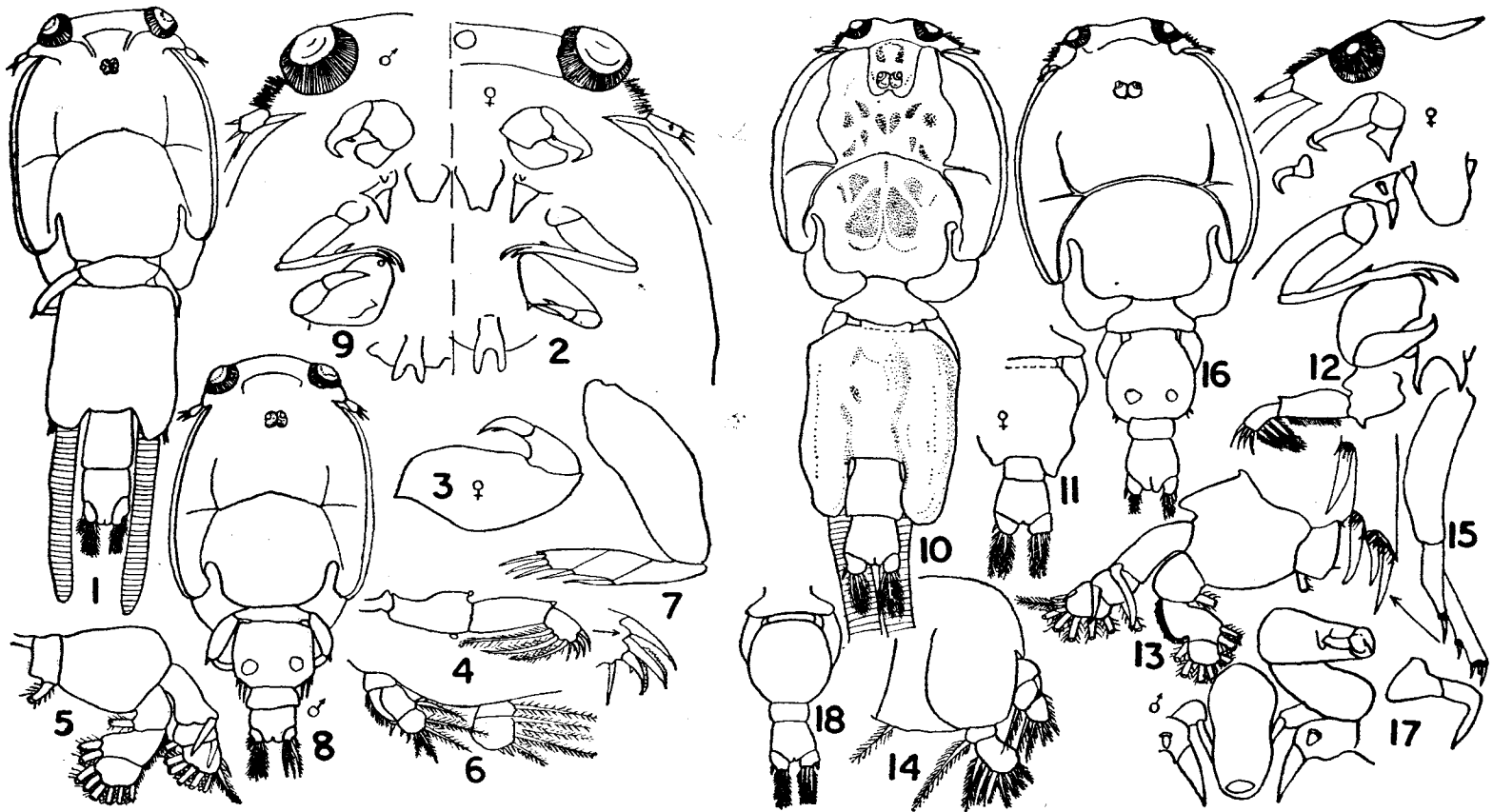


Figure 39. 1-9. *Caligus alveolaris* Heegaard. Female: 1. dorsal view; 2. mouth parts; 3. maxilliped; 4-7. first to fourth legs. Male: 8. dorsal view; 9. mouth parts. 10-18 *Caligus maculatus* Heegaard. Female: 10. dorsal view; 11. posterior region of young; 12. mouth parts; 13-15. second to fourth legs. Male: 16. dorsal view; 17. mouth parts; 18. posterior region of young (1-18 after Heegaard).

Male.—Large, about as long as female ; carapace larger than in female and wider ; genital segment small, acron-shaped with a small neck towards thoracic segment as in female ; rudimentary fifth pair of legs tipped with setae present on genital segment and can also be viewed from dorsal side of segment. Total length 5.0 mm. ; Length of carapace 3.0 mm. ; width 2.5 mm. ; length of genital segment 1.0 mm. ; length of abdomen 0.8 mm.

Scombroid hosts : (1) *Scomberomorus queenslandicus* Munro.
(2) *Scomberomorus commerson* (Lacépède).

Locality : (1 & 2). Cape Bowling Green, Cape Melville, Cape Direction, Princess Charlotte Bay, all in North Queensland ; Stephen Id., Torres Strait.

Non-scombroid hosts : None.

Location : On skin (External surface of body).

Remarks : Heegaard (1962) mentions that this species is more common on *S. commerson*. The fringe of stiff setae at the base of the claws of the fourth legs is said to be of specific importance. The spotted body and large open furca are additional characters of specific importance.

***Caligus microdontus* Heegaard, 1964**

(Figure 41 : 1-6)

(Syn : *Caligus dentatus* Heegaard, 1962. Preoccupied by *C. dentatus* P. Gadd, 1906. *Ark. Zool.*, 3(2) : 1 and hence the above name proposed by Heegaard).

Description : *Female*.—Carapace orbicular, slightly narrower anteriorly and about as long as broad ; frontal plates well developed ; lunules minute ; lateral lobes of carapace broad and well developed ; median lobe less than half width of carapace and not projecting behind lateral lobes ; free thoracic segment narrow, hardly one-third width of carapace and anteriorly constricted ; genital segment elliptical, about as long as carapace, but only half as wide and postero-laterally produced into blunt conical lobes ; abdomen two segmented, shorter than genital segment ; segments subequal, proximal shorter than distal ; anal laminae longer than broad, each bearing three long and one short terminal setae ; furca represented as delicate long fork with a bulb at base followed by a short delicate peduncle and two long slender branches which are blunt and curved in towards each other ; along anterior margin of all three exopodal joints of second pair of swimming legs a wing is present and the first and second joints of endopods have serrated anterior edges (for which the original name *C. dentatus* was given for the species) ; mouth parts and other appendages as shown in figure. Total length 4.2 mm. ; length of carapace 2.0 mm. ; width 1.7 mm. ; length of genital segment 1.3 mm. ; length of abdomen 0.85 mm. ;

Male.—Unknown.

Scombroid hosts : *Scomberomorus niphonius* (Cuvier).

Locality : Dalrymple Island, Torres Strait.

Non-scombroid hosts : None.

Location : From external surface of body of host.

Remarks : The species is based on a single female which on account of the absence of egg strings and the two-jointed condition of the terminal claw of the second maxilliped (juvenile character) appears to be an immature female.

References : Heegaard (1962, 1964).

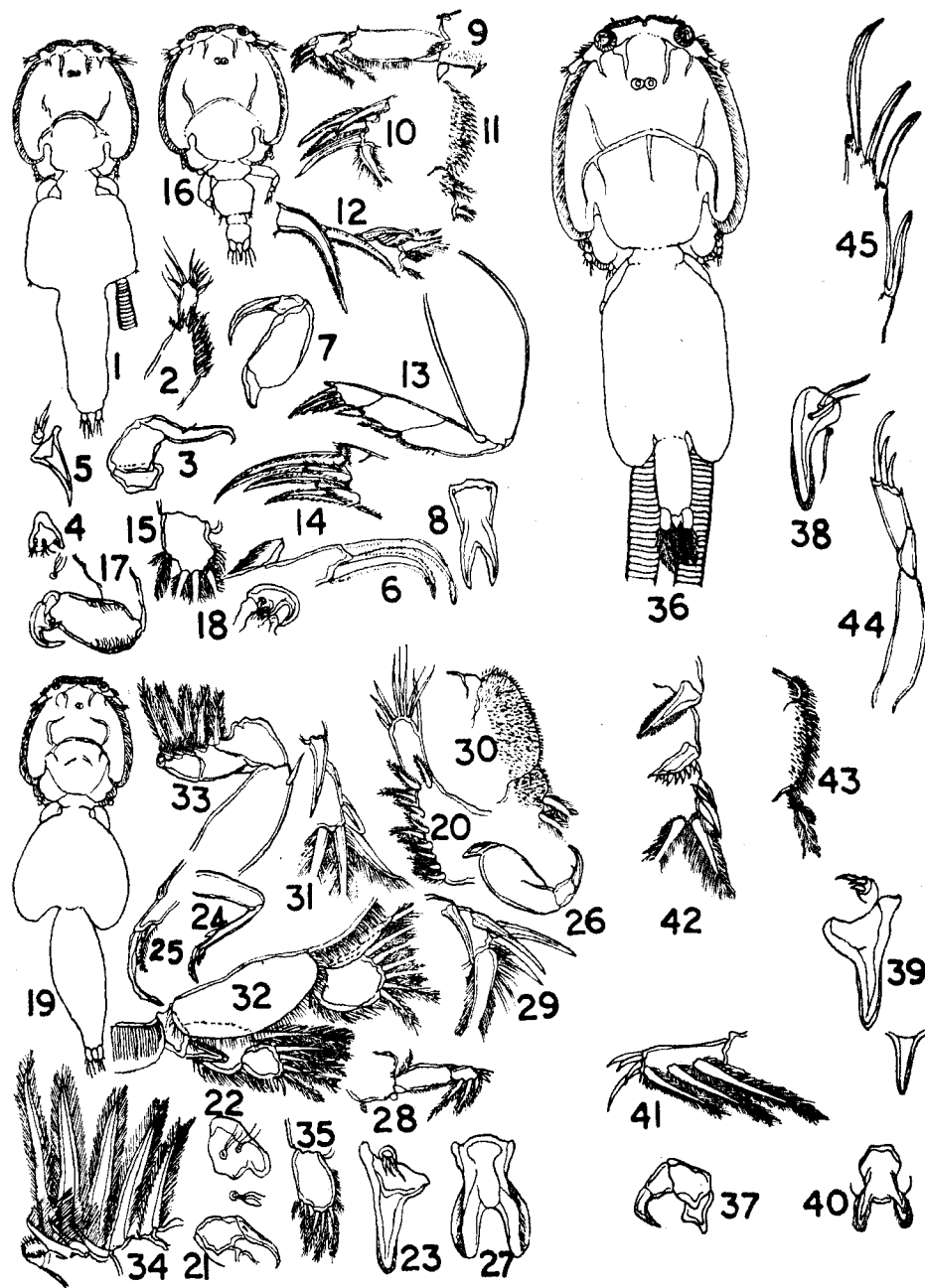


Figure 40. 1-18. *Caligus brevisoris* Shen, 1957. Female: 1. dorsal view; 2. antennule; 3. antenna; 4. maxillule; 5. maxilla; 6. first maxilliped; 7. second maxilliped; 8. sternal furca; 9. first leg; 10. apex of same, enlarged; 11-12. endopod and exopod of second leg; 13-14. fourth leg and its apex enlarged; 15. anal lamina. Male: 16. dorsal view; 17. antenna; 18. apex of same, enlarged. 19-35. *Caligus kanagurta* Pillai, 1961. Female. 19. dorsal view; 20. antennule; 21. antenna; 22. maxillule; 23. maxilla; 24-25. first maxilliped and its apex enlarged; 26. second maxilliped; 27. sternal furca; 28-29. first leg and its apex enlarged; 30-31. endopod and exopod of second leg; 32. third leg; 33-34. fourth leg and its apex enlarged; 35. anal lamina; 36-45. *Caligus amblygenitalis* Pillai, 1961. Female: 36. dorsal view; 37. antennule; 38. maxillule; 39. maxilla; 40. sternal furca; 41. apex of first leg; 42-43. exopod and endopod of second leg; 44-45. fourth leg and its apex enlarged. (After Pillai, 1961).

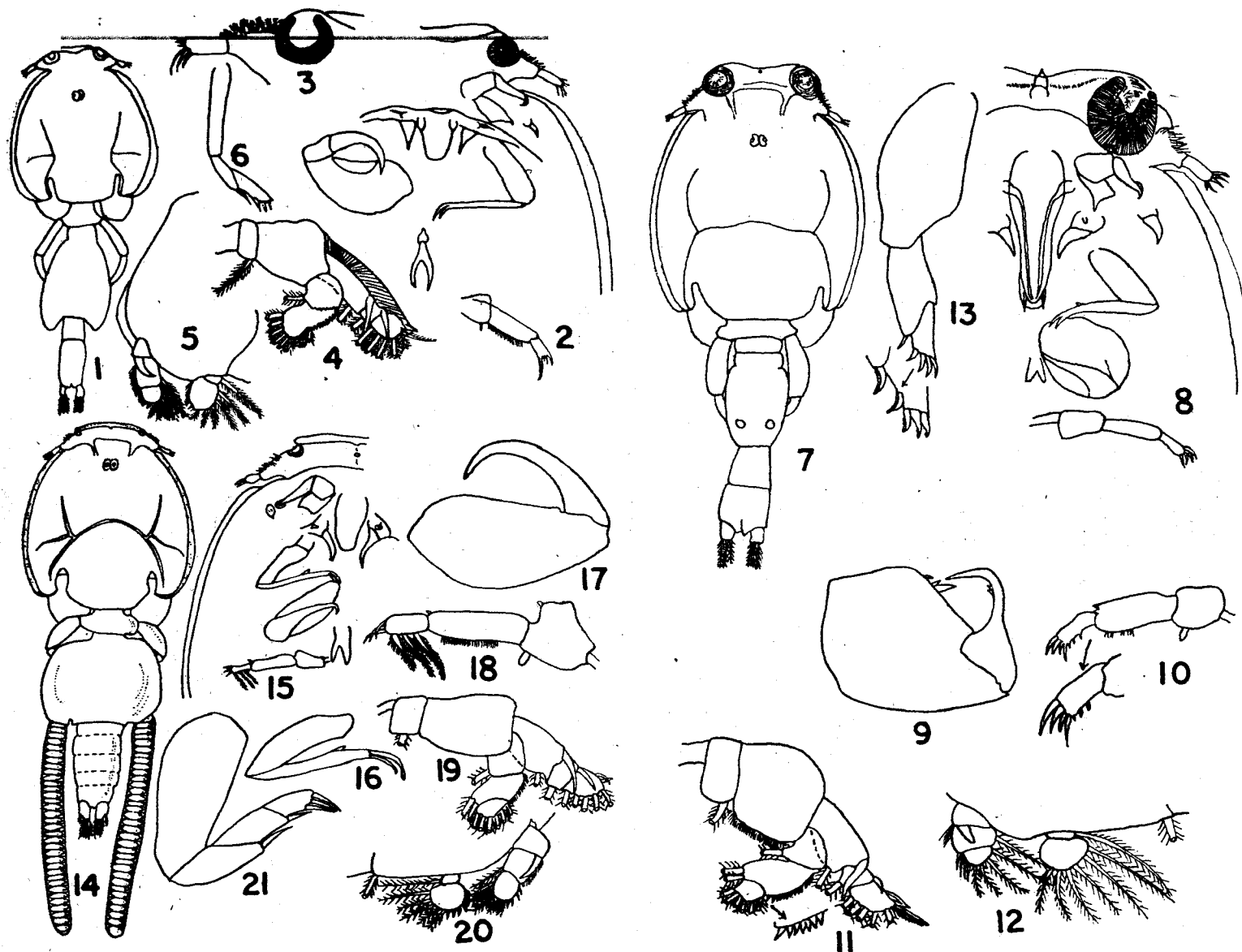


Figure 41. 1-6. *Caligus microdontus* Heegaard. Female: 1. dorsal view; 2. mouth parts; 3. antennule with lunule; 4-6. second to fourth legs; 7-13. *Caligus proboscoidatus* Heegaard. Male: 7. dorsal view; 8. mouth parts; 9. maxilliped; 10-13. first to fourth legs. 14-21. *Caligus quinqueabdominalis* Heegaard. Female: 14. Dorsal view; 15. mouth parts; 16. maxilla; 17. maxilliped; 18-21. first to fourth legs.

Caligus obovatus Heegaard, 1962

(Figure 43 : 1-7)

Description : Female.—Unknown.

Male.—Carapace circular and more than half total length ; frontal plates well formed ; lunules large, circular and project ; lateral lobes of carapace strongly incurved, but short and pointed ; median lobe less than half as wide as carapace, but projects slightly behind level of lateral lobes ; free thoracic segment narrow, about one-fourth width of carapace and anteriorly slightly constricted ; genital segment longer than broad and slightly constricted and wrinkled anteriorly giving false appearance of segmentation ; two segmented abdomen slightly longer than genital segment, segments of about equal size ; anal laminae large, as wide as long and tipped with three strong plumose setae and a small spine on distal corner ; second maxilliped with a stout square basal joint with two knobs where point of distal joint touches proximal one ; distal joint stout, curved and with a small accessory spine ; furca small with divergent branches of about same length as base, and with blunt tips ; second endopodal joint of second walking leg with dentated lamina (as in *C. proboscoidatus*) mouth parts and appendages as shown in figure. Total length (average about) 4.0 mm. ; length of carapace 2.0 mm. ; width 2.0 mm. ; length of genital segment 0.7 mm. ; length of abdomen 0.7-0.8 mm. (given erroneously in original description as 70.8 mm.).

Scombroid host : *Scomberomorus queenslandicus* Munro and *S. commerson* (Lacépède).

Locality : Off Palm Island, Cape Bowling Green, Cape Melville, Cape Direction, Princess Charlotte Bay, and Eden Reef, all from North Queensland, and from Torres Strait.

Non-scombroid hosts : None.

Location : ?

Remarks : Heegaard (1962) remarks that this species is very close to *C. proboscoidatus* (also known only from males) found on the same hosts and from the same localities. The wider carapace, remarkably large maxillule, the short mouth cone, and differences in the nature of the second maxillipeds, the furca and in the second and fourth legs differentiate *C. obovatus* from *C. proboscoidatus*. (Heegaard, 1962).

Caligus proboscoidatus Heegaard, 1962

(Figure 41 : 7-13)

Description : Female.—Unknown.

Male.—Carapace more than half total length ; longer than wide ; frontal plates well developed ; lunules large, projecting a little ; lateral lobes of carapace short and slightly curved inwards ; median lobe about half as broad as carapace and projecting slightly behind lateral lobes ; free thoracic segment narrow, but wider than genital segment ; latter longer than broad, constricted anteriorly and wrinkled giving false appearance of segmentation ; two segmented abdomen about as long as genital segment ; anal laminae short, each bearing three plumose setae ; mouth cone extraordinarily long (as in Pandaridae) ; second maxilliped with an exceptionally stout basal joint and slender strongly curved distal joint which bears two accessory spines ; in place where tip of distal joint touches proximal joint some spiny knobs present ; furca small, Y-shaped and slender ; usual three large plumose setae on posterior margin of terminal joint of first leg wanting ; instead three small spines present ; frontal side of second endopod joint of second leg fringed with a dentated wing or lamina which condition is not met within the other joints of this

appendage; basal joint of fourth leg large, distal joint shortest; five curved claws present on distal two joints of which two proximal claws are dentated from base to tip, while the three distal claws are dentated only near the tips on concave side; fifth legs wanting. Total length 2.5 mm.; length of carapace 1.35 mm.; width 1.0 mm.; length of genital segment 0.6 mm.; length of abdomen 0.5 mm.

Scombroid hosts: *Scomberomorus commerson* (Lacépède) and *Scomberomorus queenslandicus* Munro.

Locality: Cape Bowling Green, Eden Reef, and Princess Charlotte Bay, all in North Queensland, Australia.

Non-scombroid hosts: None.

Location: From mouth.

Remarks: The species is known from five young males which still retained a little of the frontal filament left from the chalimus stage. The small size, the extremely long mouth cone, the absence of plumose setae on first legs, the serrated edge of the second endopodal joint of the second legs and the dentated claws and the spines of the fourth leg are said to be diagnostic for this species. As regards the absence of plumose setae on the terminal joint of the first leg Heegaard (1962) observes 'This is unusual, although in the present Australian material the same condition is also found in *C. obovatus*. In *C. dentatus* this same posterior margin is even naked.' All these three species are small and delicate.

Caligus quinqueabdominalis Heegaard, 1962

(Figure 41: 14-21)

Description: *Female*.—Carapace orbicular, narrower anteriorly and slightly longer than wide; frontal plates broad, lunules minute and placed wide apart; lateral lobes short, median lobe projects slightly behind posterior end of lateral lobes; free thoracic segment narrow, about half as wide as genital segment and bearing a narrow neck towards carapace; genital segment is wider than long, about two-thirds width of carapace and with strongly curved lateral margins; five segmented abdomen of same length as genital segment; abdominal segments about equal in size; anal laminae short bearing small setae; antennule short, about two-thirds as long as frontal plate and with terminal joint shorter than basal joint; branches of furca shorter than base; mouth parts and appendages as shown in figure; fifth pair of legs wanting. Total length 4.7 mm.; length of carapace 2.2 mm.; width 2.0 mm.; length of genital segment 1.1 mm.; length of abdomen 1.0 mm.; length of egg-strings 2.7 mm. (eggs large).

Male.—Unknown.

Scombroid host: *Scomberomorus commerson* (Lacépède).

Locality: Torres Strait.

Non-scombroid hosts: None.

Location: ? (Probably external surface of body of host).

Remarks: The five-segmented abdomen is said to be the most important feature of this species.

Caligus rapax H. Milne-Edwards, 1840

Heegaard (1962) records this species hitherto known only from the Atlantic and the Mediterranean from the Australian waters based on 20 females 'parasitic on a skate (*Raja*)' from Oyster Bay, Tasmania, in the collection of the Australian Museum (Reg. No. 6792). This is one of the species which is known to occur on a wide variety of fish hosts and

according to, Heegaard (1962) this is on account of both the males and females being more lively than in most species and 'frequently displaying this activity by leaving a host and swimming freely about. This happens more at night than during daytime, as evidenced by several investigators who have recorded the capture of both sexes in two nets, together with non-parasitic copepods.' This extension in the recorded distribution of this species is noteworthy.

***Caligus thynni* Pillai, 1963**

(Figure 42 : 1-11)

Description : Female.—Carapace distinctly longer than broad, anteriorly narrow ; large circular lunules slightly projecting from broad well developed frontal plates ; postero-median lobe broad, projecting well beyond level of lateral lobes ; fourth thoracic segment broader than long ; genital segment triangular, anteriorly narrowed and longer than broad ; one segmented abdomen short and squarish ; short anal laminae sunk in abdomen and not extending beyond posterior end of abdomen ; claws on endopod of second leg large, winged, first twice the size of second, third slender ; first segment of endopod of second leg with four sharp spines, second segment with a row of nine teeth ; fourth leg slender, basal segment as long as rest of limb, but not broader ; claws not elongate, apical claw twice as long as penultimate claw ; Other mouth parts and appendages as shown in figure. Total length 3.5 mm.

Male.—Unknown.

Scombroid host : *Euthynnus affinis* (Cantor) [= *Euthynnus affinis ffainis* (Cantor)].

Locality : Trivandrum, S.W. Coast of India.

Non-scombroid hosts : None.

Location : Gill arch.

Remarks : The species is described from a single female found along with several specimens of *C. kuroshio* Shiino from the same host. In the shape of the genital segment the species is said to resemble *C. isonyx* Steenstrup and Lutken, and *C. triangularis* Shiino, but the longer abdomen of *C. isonyx* and the shape of the anal laminae and the armature of the endopod of the second leg in *C. triangularis* are said to differentiate the latter two from *C. thynni*. As to the validity of his new species, Pillai (1963) remarks that 'Since I have only a single female, probably slightly abnormal, the identification may be considered provisional.'

The species name *Caligus thynni* Pillai, 1963 is preoccupied by *Caligus thynni* Dana, 1852 emended to *Caligus thynni* by Scott, T. (1914) and as such a new name will have to be proposed for this species as the name *C. thynni* is not available for use. It will be desirable if the author whose attention is being drawn to this could also give a redescription of this species based on more material. Reference may also be made to the information given under the species *Caligus thynni* Dana, on p. in the earlier part of this paper.

Family : EURYPHORIDAE

Genus *Caligulus* Heegaard, 1962

Generic characters as for *Caligus* and in addition the dorsal plate of third thoracic segment entirely covers fourth segment.

Heegaard (1962) places this genus under the family Euryphoridae. Monotypic. Genotype *C. longispinosus* Heegaard.

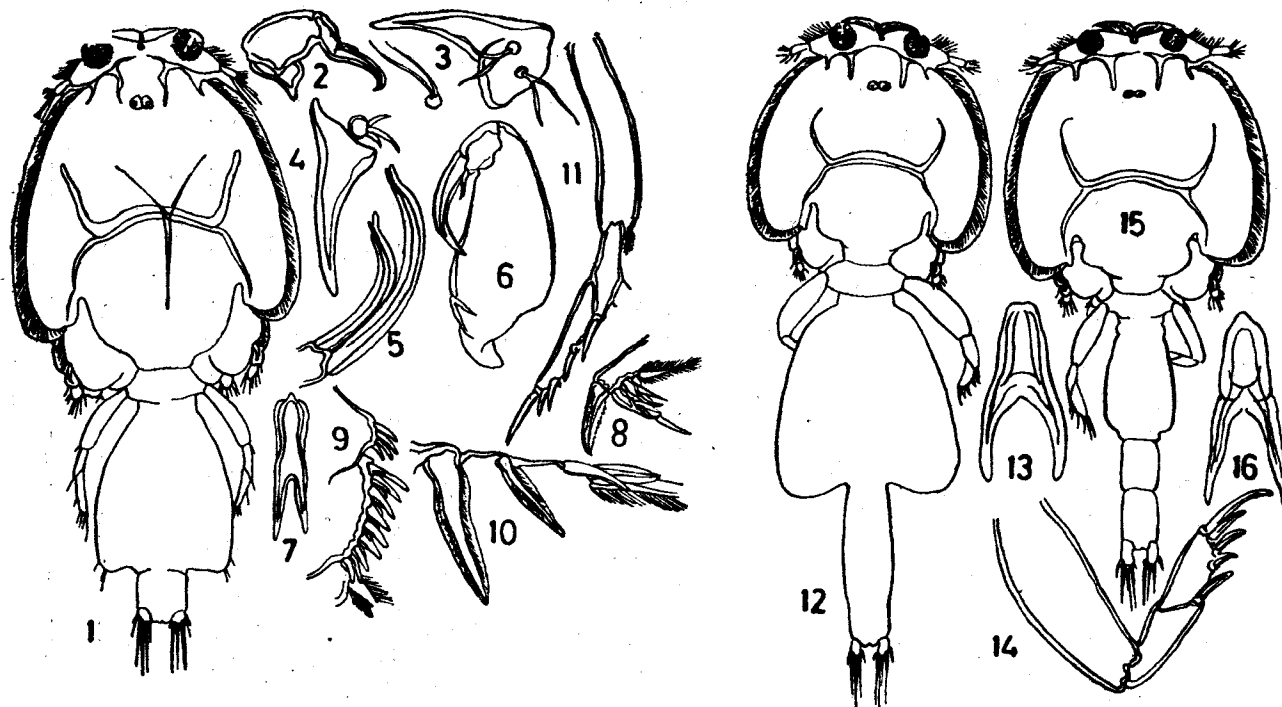


Figure 42. 1-11. *Caligus thynni* Pillai, 1963c. Female: 1. dorsal view; 2. antenna; 3. maxillule; 4. maxilla; 5. first maxilliped; 6. second maxilliped; 7. sternal fork; 8. first leg, tip of exopod; 9. second leg, endopod; 10. same, exopod; 11. fourth leg. 12-16. *Caligus kuroshio* Shiino, 1959. Female (12-14): 12. dorsal view; 13. sternal fork; 14. fourth leg. Male (15-16): 15. dorsal view; 16. sternal fork. (After Pillai, 1963).

Caligulus longispinosus Heegaard, 1962

(Figure 43 : 8-18)

Description : Female.—Carapace markedly elongate, about one-half times greater than width ; lateral margins of carapace nearly parallel ; lunules of moderate size not jutting beyond edge of frontal plates which are wide and separated from carapace by anterior transverse ridge ; lateral lobes of carapace are short ; median lobe large, about two-thirds width of carapace and extending backwards forming dorsal plate entirely covering fourth thoracic segment and even part of genital segment ; genital segment quadrangular with a deep wide incision postero-medially in which one-segmented abdomen with a pair of anal laminae (not one lamina as mentioned by Heegaard, p. 171, 1962) is situated. Mouth parts and appendages as figured (Figure 43). Fifth and sixth pairs of legs wanting in female. Egg strings long, slender, longer than total length. Total length 3.5 mm. ; carapace length 2.5 mm. ; width 1.6 mm. ; length of genital segment 0.9 mm. ; width 1.0 mm.

Male.—About same size as female, but with frontal plates and lunules more prominent ; carapace relatively larger and broader than in female ; genital segment more elliptically rounded than in female ; lateral lobes of genital segment tipped with two short spines representing vestigial fifth pair of legs ; maxilla, and sternal furca are relatively larger than in female. Total length 3.2 mm. ; carapace length 2.7 mm. ; width 1.8 mm. ; length of genital segment 0.6 mm. ; width 0.8 mm.

Scombroid host : *Euthynnus alletteratus* (= *Euthynnus affinis yaito* Kishinouye).

Locality : Howick Island, North Queensland.

Non-scombroid hosts : None.

Location : On skin (external surface of body of host).

Remarks : Heegaard (1962) mentions that in addition to the large dorsal plates of carapace the species 'can be recognised principally by its swimming legs and the accessory spine on the second antenna.'

Genus **Euryphorus** Nordmann, 1832**Euryphorus nympha** Steenstrup and Lutken, 1861

Ho (1963) has given a redescription of this species based on males and females collected from the inner surface of the operculum of the common dolphin *Coryphaena hippurus*. He found that each female carried a male beneath its genital segment and both sexes had their ventral surfaces in contact with each other and had their body axis in the same direction. Remarking on Shiino's (1959) relegation of *Euryphorus nordmanni* Kirtisinghe to the synonym of the above species, Ho draws attention to two differences, namely, the nature of the rudimentary fifth legs and the posterior processes of the genital segment of the female described by Kirtisinghe, from the typical *E.nympha*, and suggests that 'Kirtisinghe's *E.nordmanni* is merely a local variety of *E.nympha*.'

Genus **Gloiopotes** Steenstrup and Lutken, 1861**Gloiopotes longicaudatus** (Marakawa), 1925

(Figure 45 : 7-9)

Heegaard (1962) while remarking on the previous records of this species by Marukawa (1925), Yamaguti (1936) and Shiino (1954) from the scombroid fishes *Tetrapturus mitsukurii* Jordan and Snyder, *Parathynnus sibi* (Temminck and Schlegel), *Xiphias gladius* Linnaeus from the Pacific

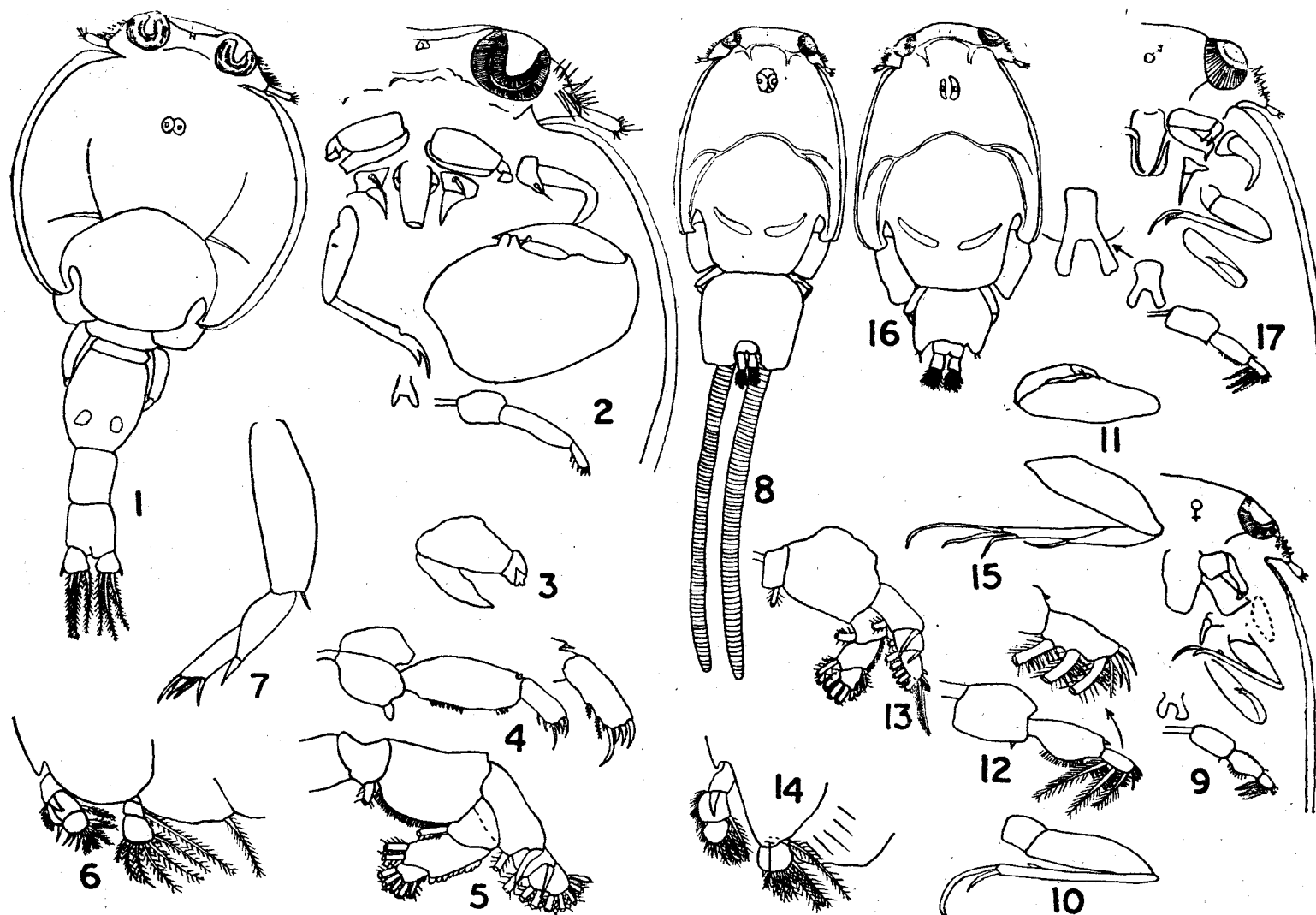


Figure 43. 1-7. *Caligus obovatus* Heegaard. Male: 1. dorsal view; 2. mouth parts; 3. antenna; 4-7. first to fourth legs. 8-18. *Caligulus longispinosus* Heegaard. Female: 8. dorsal view; 9. mouth parts; 10-11. maxilla and maxillipeds; 12-15. first to fourth legs; Male: 16. dorsal view; 17. mouth parts (1-17 after Heegaard).

coast of Japan and the Mariana Islands and from an unknown host collected at the Palao Island, also records this species from the following hosts and localities from Australia :

Scromboid hosts : (1) *Marlina zelandica* (= *Tetrapturus audax* Philippi) ; (2) *Istiompax australis* [= *Makaira indica* (Cuvier)].

Localities : (1) From striped marlin caught at Bateman's Bay, New South Wales, and (2) from the black marlin caught at Port Jackson and off Broughton Island, Port Stephen, New South Wales.

Location : skin near anal fin of striped marlin ; gill opening of black marlin.

Non-scombroid hosts : None.

Remarks : Heegaard (1962) draws attention to slight differences noticeable between his drawings of this species and the descriptions and drawings of it given by the aforementioned Japanese workers.

Ho (1963) has given descriptions of the males and females of this species based on material collected from the general body surface and the ventral surface of the ' sword ' of *Xiphias gladius* Linnaeus and *Istiophorus orientalis* (Temminck and Schlegel) (= *I. gladius*) caught from the Pacific coast off Suao and in the vicinity of the islets of Keelung. He also remarks on specimens in his collection differing from existing descriptions of the species in (1) the number of setae on the apex of the first antenna ; (2) the disposition of soft hairs and spines on the carapace ; and (3) armature of the terminal segment of the first leg, the fourth leg and the caudal rami.

***Gloiopotes watsoni* Kirtisinghe, 1933**

Kurian (1955) reports both males and females of this species from the scombroid fish *Histiophorus gladius* (Brouss.) (= *Istiophorus gladius* (Broussonet) landed at Vizhingam, S.W. coast of India, in 1952. The specimens are said to resemble the type described by Kirtisinghe (1933) except that the caudal rami are slightly shorter than the second abdominal somite, whereas in the type they are longer than the second abdominal somite.

Measurements : Female (Male) : Total length excluding anal laminae 10.7 (10.0) ; length of carapace 5.3 (4.4) ; and width of carapace 4.5 (3.2) mm.

Genus *Tuxophorus* Wilson, 1908

Diagnosis : Entire body more or less distinctly segmented and depressed ; fourth segment narrowed ; genital segment enlarged, often to the size of the carapace ; three anterior segments fused with the head ; first and fourth legs uniramous ; second and third pairs biramous ; fourth segment separated from fifth with paired dorsal plates, overlapping genital segment in female, but rudimentary in male ; frontal plates with lunules ; claws on first legs simple ; genital segment with lobes and rudimentary legs at its posterior corners. External parasites of fishes.

***Tuxophorus cervicornis* Heegaard, 1962**

(Figure 45 : 1-6)

Description : *Female*.—Carapace oval, little longer than wide and length about half of total length ; frontal plates prominent ; lunules small and widely separated ; median posterior lobe of carapace about half as wide as carapace and projects very slightly beyond tip of

lateral lobes which are broad and incurved ; fourth segment free and about two times as wide as long, covered with a pair of lobular wings ; latter extend outwards to a level with the lateral margins of genital segment and far enough backwards to cover its base. In adults with the development of a neck in the fourth segment, the wings get distinctly separated from posterior margin of carapace ; genital segment quadrangular, broader than long ; about two-thirds as wide as carapace ; fifth pair of legs in the form of branched spiny processes at postero-lateral corners of genital segment ; abdomen about as long as genital segment and two segmented, second segment being 1.5 times length of first ; egg strings with about 60-100 eggs each ; antenna three segmented, first joint which is coalesced with carapace possesses a posteriorly directed spine, second and third joints free, last ending in a strong hook ; maxillule and maxilla devoid of palps ; first maxilliped long and slender as in *Caligus*, but differs in being three segmented and having a minute palp at base of third segment ; distal segment ends in a pair of digitiform processes ; second maxilliped also three segmented, the third segment ending in a claw ; sternal furca strongly developed rather simple with a massive base and with dagger-shaped diverging arms ; other appendages as figured.

Male.—Unknown.

Scombroid host : *Scomberomorus commerson* (Lacépède).

Locality : Torres Strait ; and Cape Direction, North Queensland.

Non-scombroid hosts : None.

Location : Mouth and probably also gills.

***Tuxophorus cybii* Nunes-Ruivo, 1956**

We have not been able to see the original description of this species, but from Heeggard (1962, p. 173) note that the furcal structure is not simple as in *T. cervicornis*, but has an extra spine on each branch.

***Tuxophorus solandri* Kurian, 1962**

(Figure 44 : 25-36)

Description : *Female*.—Carapace ovate, rounded in front with a short incision in centre of anterior margin ; frontal plates distinct ; lunules moderate ; median posterior lobe of carapace projecting beyond tip of lateral lobes and about half width of carapace ; lateral lobes broadly rounded and incurved ; free thoracic segment short and with a wing on each side, each wing extending outwards beyond level of median lobe of carapace and overlaps part of genital segment ; wings broadly triangulate ; genital segment broader anteriorly, width of anterior part equalling length of segment ; midventral side with five or six rows of posteriorly directed short curved spines, not hitherto noted for other species of genus ; abdomen shorter than genital segment ; two-jointed and tapering, second segment very small, about three-tenths length of first (in figure shown as about one seventh) ; anal laminae tapering, about half as long as abdomen, with a tooth on outer margin and three short terminal setae ; antennule two-jointed, setose, basal joint stout, about two times as long as distal ; maxillule in form of large plate with a curved terminal spine and a node at outer edge ; arms of furca widely divergent with pointed apices which are short in relation to massive basal part ; outer sides of furca with sharp claws ; first maxilliped long, two-jointed, basal joint stout, terminal claw slender, about 1.5 times length of basal, with two unequal curved distal spines ; second maxilliped with basal joint long and stout and terminal claw long and curved with an accessory spine on its inner side ; fourth leg four-jointed, basal joint much stouter and longer than other three joints combined ; second and third segments each with a terminal spine and fourth with three spines ; fifth leg at postero-lateral corner of genital segment extends backwards and outwards as a strong claw bearing two or three short spines ; sixth legs small, digitiform, with three small setae ; fifth and sixth legs visible dorsally. Total length including laminae 7.9 mm.

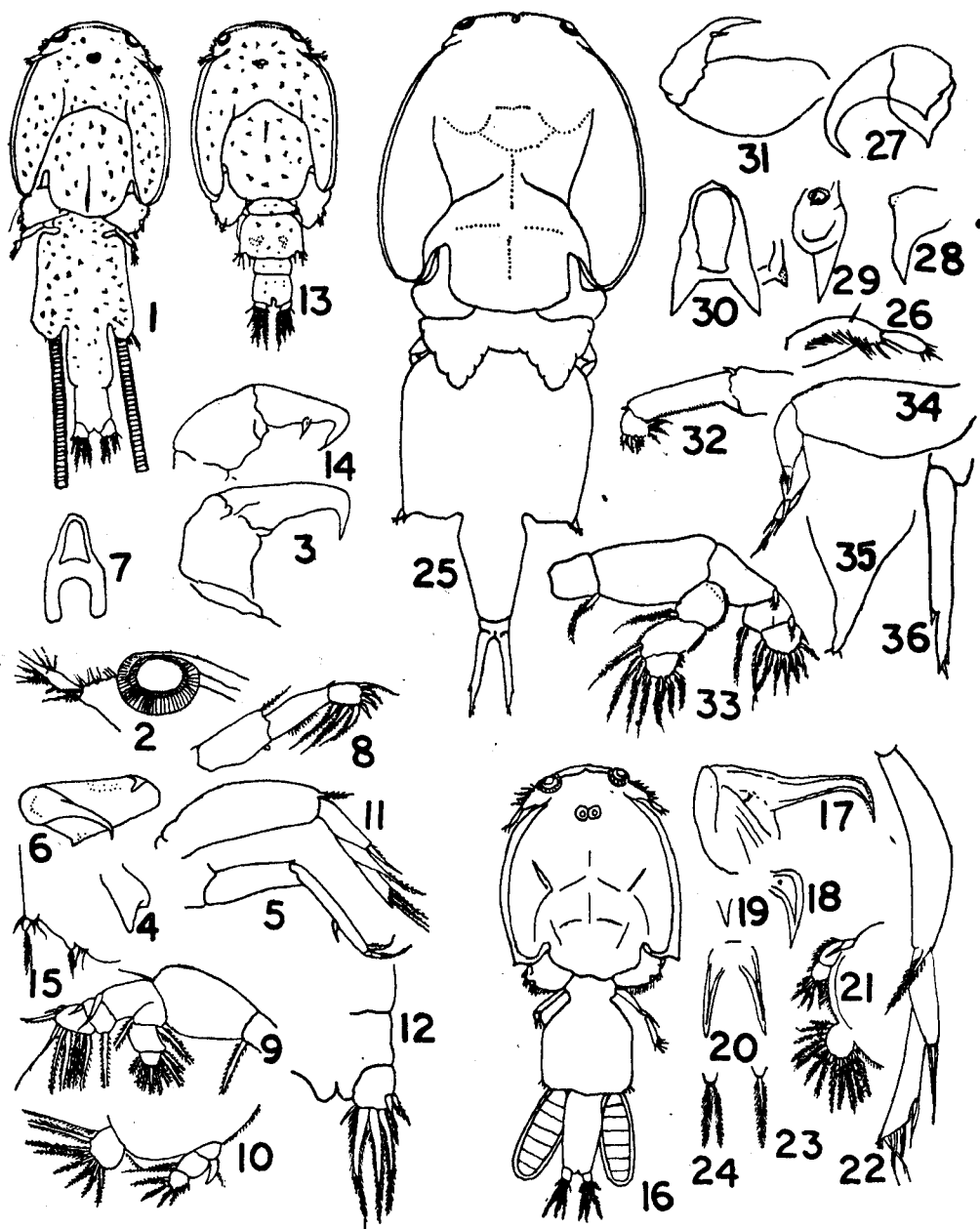


Figure 44. 1-15. *Caligus euthynnus* Kurian. Female: 1. dorsal view; 2. antennule with lunule; 3. antenna; 4. maxilla; 5-6. first and second maxillipeds; 7. sternal furca; 8-11. first to fourth legs; 12. anal lamina; Male: 13. dorsal view; 14. antenna; 15. fifth and sixth legs. 16-24 *Caligus affinis* Kurian. Female: 16. dorsal view; 17. antenna; 18. maxillule; 19. maxilla; 20. sternal furca; 21. third leg; 22-24. fourth to sixth legs. 25-36 *Tuxophorus solandri* Kurian. Female: 25. dorsal view; 26. antennule; 27. antenna; 28. maxillule; 29. maxilla; 30. sternal furca; 31. maxilliped; 32-33. first and second legs; 34-35. fourth and fifth legs; 36. anal lamina. (1-36 after Kurian).

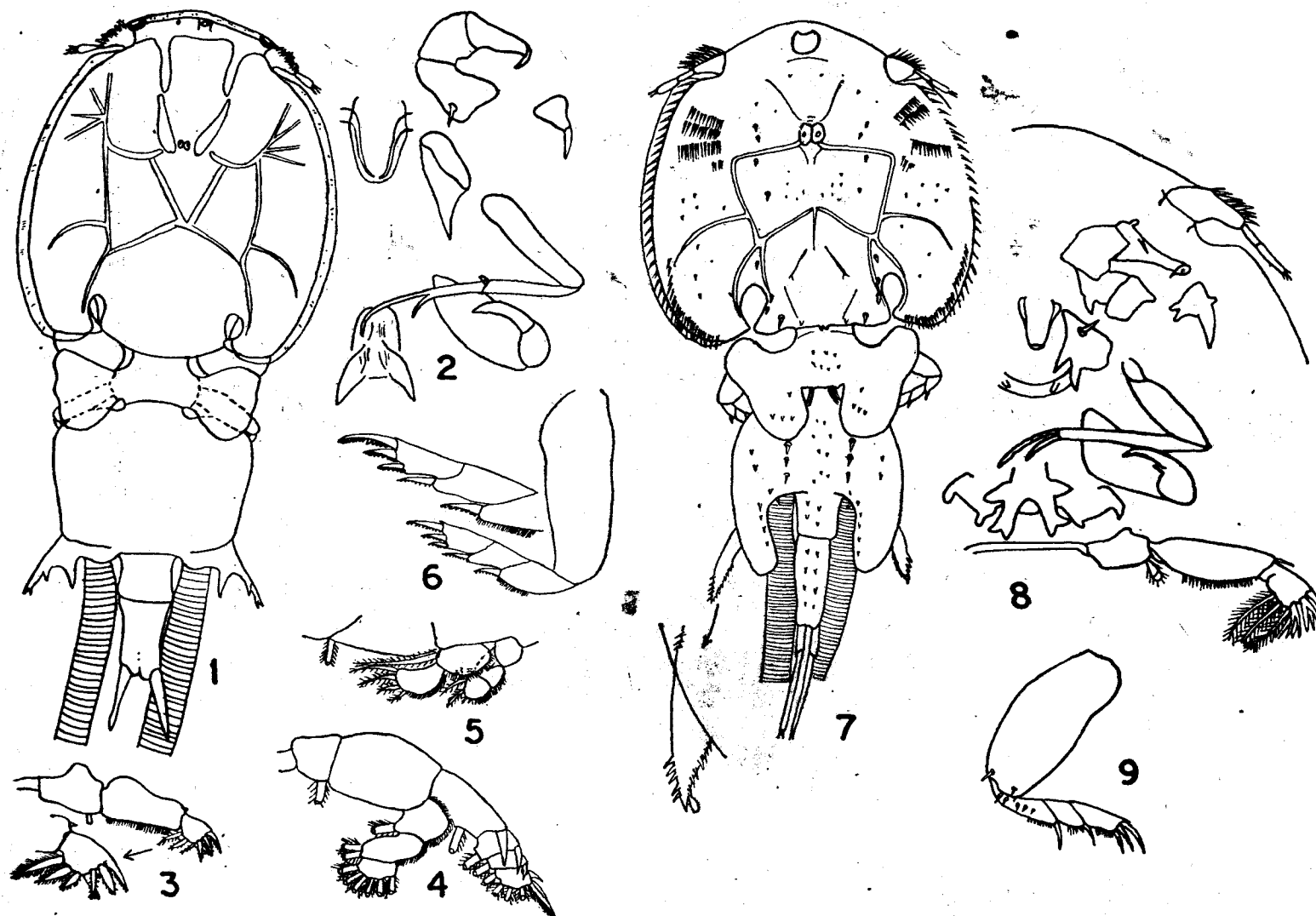


Figure 45. 1-6. *Tuxophorus cervicornis* Heegaard. Female: 1. dorsal view; 2. mouth parts; 3-6. first to fourth legs 7-9. *Gloiopotes longicaudatus* (Marukawa). Female: 7. dorsal view; 8. mouth parts; 9. fourth leg. (1-9 after Heegaard).

Male.—Unknown.

Scombroid host : *Acanthocybium solandri* (Cuvier).

Locality : Munambom, Kerala, South West coast of India.

Non-scombroid hosts : None.

Location : External parasite.

Remarks : This species is known from an adult female (Holotype) (Kurian, 1961, p. 74) although he has given the description under 'Adult male'. The figures and descriptions given are convincingly of the female.

The author also gives a key for the identification of the following four species : *T. caligoides* Wilson, *T. wilsoni* Kirtisinghe, *T. tylosuri* Rangnekar, and *T. solandri* Kurian. Of these, *T. tylosuri* is considered by Pillai (1961) as belonging to the genus *Caligus*. Of the above four species only *T. solandri* is known from a scombroid host. Two additional species of *Tuxophorus* from scombroid hosts (recently described) are, *T. cybii* Nunes-Ruivo (1956), and *T. cervicornis* Heegaard (1962).

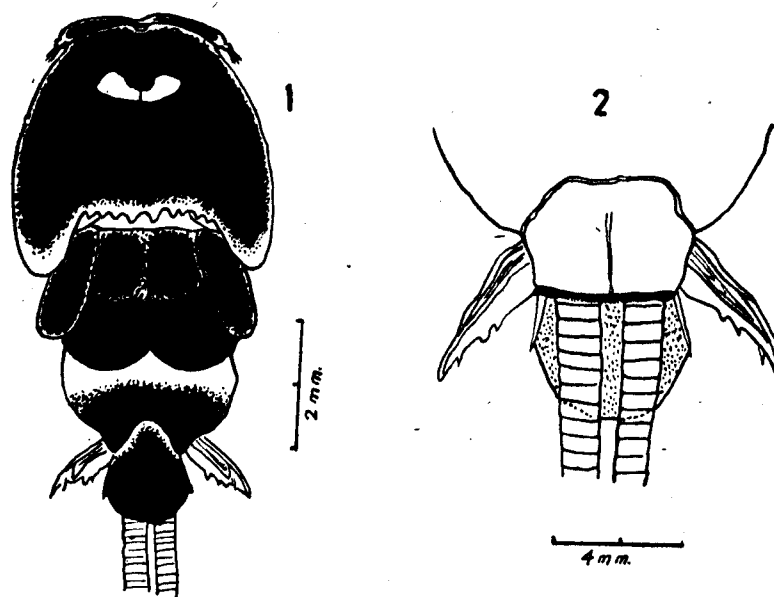


Figure 46. 1-2. *Pandarus satyrus* Dana. Female : 1. dorsal view ; 2. ventral view of posterior part (After Ju-Shey Ho, 1963).

Family : PANDARIDAE

Genus *Pandarus* Leach, 1816

Pandarus satyrus Dana, 1852

(Figure 46 : 1-2)

(Syn : *Pandarus zygaenae* Brasy, 1883).

Scombroid host : *Makaira mitsukurii* (Jordan & Snyder) (= *Tetrapturus audax* Philippi).

Locality : ? Japan.

Non-scombroid hosts : *Zygaena malleus* (Kermadec Island and Cape Verde Islands) ; *Prionace glauca* (Hawaii) ; *Carcharhinus brachyurus* (Gulf of Mexico, and Pacific coast off Suao or in the vicinity of islets of Keelung) ; *Sphyrna zygaena*, *Isuropsis glauca*, *Glyphis glaucus* (= *Prionace glauca*), *Alopias pelagicus*, and *Carcharhinus platyrhynchus* (Japan).

Location : Externally on various parts of body.

Remarks : The lone scombroid host for this species otherwise found on sharks is interesting, and raises doubts as to whether there could not have been an accidental transfer of the parasite from shark to marlin on the deck of the fishing vessel !

References : Yamaguti (1936), Ho (1963), Shiino (1954, 1957, 1959).

Family : ANTHOSOMIDAE

Genus *Lernanthropus* Blainville

Lernanthropus kanagurta Tripathi

(Figure 47 : 1-5)

Description : *Female*.—Size small (total length up to 2.3 mm.) ; Cephalothorax quadrangular and narrower than thorax ; lateral sides folded ventrally extend anteriorly like two horns covering first antenna ; neck formed of fusion of first thoracic segment with cephalon ; dorsal plate divided into two almost equal sizes ; genital segment, abdomen and about one fifth of fourth leg covered by posterior dorsal plate ; genital segment round and small ; one segmented abdomen about half as broad as genital segment ; anal laminae about two-thirds as long as abdomen and having small papillae at posterior end ; antennule seven segmented, basal segment longest and distal segment smallest bearing four setae at tip ; antenna two jointed, prehensile with second joint terminating in a strong claw the inner side of which is bull-shaped and roughened ; mouth tube as for genus ; maxillule biramous with oval basipodite and one-jointed conical exopodite bearing two setae ; endopod smaller with single broad seta ; maxilla two-jointed, inner margin of distal joint with three small spines ; maxillipeds two-jointed, second joint ending in a curved claw ; first leg biramous, rami single jointed ; basipodite with a spined papilla ; exopod with five broad spines, endopod with two short and one long spine ; third leg uniramous, broadly ovate and extends ventro-laterally ; fourth leg biramous and divided up to base, the exopod slightly longer than endopod ; egg sacs long, uniseriate with slightly flattened eggs.

Male.—Body short ; cephalothorax trapezoidal with round corners ; first thoracic segment fused with cephalon ; free part of thorax cylindrical, decreasing in width posteriorly ; genital segment indistinct ; abdomen one-segmented ; anal laminae conical and nearly twice length of abdomen, each with two apical setae and one seta in middle near outer margin ; antennule six-jointed, distal segment smallest bearing three apical setae ; antenna two-jointed, prehensile, second joint clawed ; maxillule and mouth parts as in female ; maxilla two-jointed, second joint clawed and having on its inner side three rows of four spines each ; maxilliped two-jointed, distal joint clawed and inner margin of basal segment with nearly 25 small spines ; first and second legs as in female ; third leg uniramous, long and tubular ; fourth leg biramous, exopod longer than endopod and bifurcated for more than three-fourths its length.

Measurements : *Female*.—Total length 2.175-2.363 ; cephalothorax $0.87-0.89 \times 0.638-0.797$; thorax 1.42×0.725 ; genital segment $0.145-0.159 \times 0.217$; abdomen $0.116-0.13 \times 0.116-0.13$; anal lamina $0.13-0.145$; fourth leg exopod 1.887×0.159 ; endopod 1.01×0.13 ; egg sacs $2.196-2.329$; eggs $0.092-0.043 \times 0.188-0.203$; antennule 0.145 ; antenna 0.464.

Male.—Total length 0.913 ; cephalothorax 0.435×0.435 ; thorax 0.42×0.39 ; genital segment 0.029×0.101 ; abdomen 0.043×0.058 ; anal lamina 0.087×0.021 ; third leg 0.43×0.072 ; fourth leg exopod 0.362×0.043 ; endopod 0.261×0.029 .

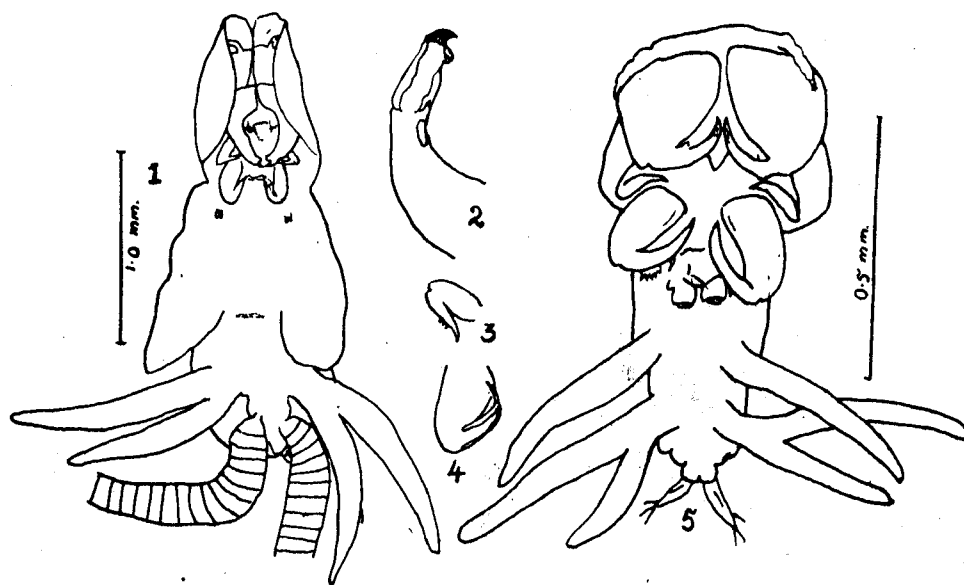


Figure 47. 1-5. *Lernanthropus kanagurta* Tripathi. Female : 1. ventral view ; 2. antenna ; 3. maxilla ; 4. maxilliped ; Male : 5. ventral view (after Tripathi, 1962).

Scombroid host : 1. *Rastrelliger kanagurta* (Cuvier).

Locality : Puri, Orissa Coast, India.

Non-scombroid host : *Megalaspis cordyla*.

Location : Gills.

Reference : Tripathi (1962).

Family : PSEUDOCYCNIDAE

Tripathi (1962) places the genus *Pseudocycnus* under the family Dichelestidae and subfamily Pseudocycninae. Heegaard (1962) recognises the family Cycnidae Kroyer (1863) in preference to Pseudocycnidae Wilson (1932) and describes a new genus *Paracycnus*, with *P. lobosus* Heegaard as the genotype. However, in this 'Addendum' also we continue the use of the family name Pseudocycnidae.

Heegaard (1962) also recognises four genera under the family Cycnidae (=Pseudocycnidae), namely *Cycnus*, *Paracycnus*, *Helleria*, and *Pseudocycnus* and distinguished them on the basis of the combination of characters shown in the following table :

	<i>Cycnus</i>	<i>Paracycnus</i>	<i>Helleria</i>	<i>Pseudocycnus</i>
1 segment	Fused with head	Fused with head	Not fused with head	Fused with head
Following segments	2, 3 segm. free, rest fused with genital segm.	2 segm. free, rest fused with genital segm.	1, 2, 3 segm. free, rest fused with genital segm.	2, 3 segm. free, rest fused with genital segm.
A ₁	Several joints	Several joints	As in <i>Paracycnus</i>	Few joints
A ₂	Subchela	Subchela	Like <i>Paracycnus</i>	Subchela
Mx	Vestigial	Vestigial	3-jointed, small	Vestigial
Mxp-1	Vestigial	3-jointed, small	3-jointed, small	3-jointed, small
Mxp-2	Delicate	Enormously large	Large, like <i>Paracycnus</i> , except for basal joint.	Well developed
Pe-1	Bifurcate	Uniramose, 4-jointed	Pe ₂ uniramosal	Uniramose, 1 joint
Pe-2-4	Bifurcate, jointed	Bifurcate, unjointed	Pe ₃ missing, Pe ₄ uniramosal	Pe ₂ bifurcate, unjointed, Pe ₃₋₄ uniramosal

The answer as to whether these four groups merit generic status or not should await a review of the family and until such time tentative recognition is given to *Paracycnus* Heegaard. As regards this genus, Heegaard (1962) remarks that it '... is very closely related to *Cycnus* and *Pseudocycnus*' and 'Bassett-Smith's *Helleria* is another genus with some striking resemblances to the new *Paracycnus*.'

We have already mentioned (p. 928) that the generic name *Helleria* Bassett-Smith (1898a) being preoccupied, Bassett-Smith himself (1898b) proposed the name *Cybicola* to replace it with *Helleria armata* Bassett-Smith (= *Cybicola armata* (Bassett-Smith) as the genotype). Kirtisinghe (1937) has given ample reasons for considering *Cybicola* Bassett-Smith a synonym of *Pseudocycnus* Heller with which we agree. Recently, however, Tripathi (1962) has recognised *Cybicola* as a subgenus of *Pseudocycnus* and these nomenclatorial changes will have to be taken into account for evaluating the status of the genera of Pseudocycnidae recognised by Heegaard (1962).

The following combination of characters were used by Tripathi (1962) to group the species of *Pseudocycnus* Heller under two subgenera:

Antennule three- or four-jointed first thoracic segment fused with cephalon; second and third thoracic segments with no lateral lobes (*Pseudocycnus* s. str.).

Species:

- P. (P.) appendiculatus* Heller.
- P. (P.) buccatus* Wilson.
- P. (P.) spinosus* Pearse.

Antennule seven-jointed; first thoracic segment not completely fused with cephalon; second and third thoracic segment with lateral lobes which may or may not be papillose (*Cybicola* Bassett-Smith and not *Cybicola* sub-gen. nov. as given by Tripathi).

Species:

- P. (C.) armata* (Bassett-Smith).
- P. (C.) elongata* Pearse.
- P. (C.) scomberesocis* Yamaguti.

Genus *Paracynus* Heegaard, 1962

The diagnostic characters of the genus are given in the table on p. 985.

Paracynus lobosus Heegaard, 1962

(Figure 48 : 1-9)

Description : Female.—Carapace ovate, anteriorly narrow and lateral margins curved into well rounded lobes ; posterior corners of carapace prolonged into well-rounded lobes ; free second segment wider than carapace with free lateral margins drawn out into postero-laterally pointing lobes ; third segment with double lateral lobes, while fourth segment with single lateral lobe as second segment ; the trunk formed also of the fusion of fifth and genital segment long, cylindrical and of uniform width ; one segmented abdomen markedly short, broader than long and carries a pair of long caudal rami broader at their bases and tapering towards their tips. Antennule long, slender, seven-jointed with horn-like seta on second joint ; and common setae on other joints except one, two and four ; antenna three-jointed and prehensile third joint of antenna very movable and can be bent backwards to form a subchela with second joint ; mouth cone short, maxilla rudimentary ; second maxillipeds large and prehensile ; first maxilleped vestigial and present as a small three-jointed organ at inner base of second maxilliped ; first pair of legs uniramous, four-jointed ; second, third and fourth legs with sympodial bulb with two small unjointed lobes representing exopod and endopod, each furnished with a short seta. Head 0.9 mm. ; greatest width 1.1 mm. ; length of free segment 0.5 mm. ; trunk 5.0 mm. ; and width of trunk a little less than 1.0 mm.

Male.—Unknown.

Scombroïd* hosts : (1) *Scomberomorus commerson* (Lacépède). (2) *Scomberomorus queenslandicus* Munro.

Localities : (1) Cape Direction, North Queensland ; and Torris Strait. (2) Eden Reef and Princess Charlotte Bay, North Queensland.

Non-scombroïd hosts : None.

Location : ? (Most probably gills).

Remarks : There is hardly any need to draw attention to the several similarities of this species to *Pseudocynus armatus* Bassett-Smith.

Genus *Pseudocynus* Heller, 1865*Pseudocynus armatus* (Bassett-Smith), 1898

Remarks : Kurian (1961) recorded ovigerous females (total length of one : 5.6 mm. inclusive of anal laminae ; egg case 6.4 mm. long) from the gills of the scombroïd fish *Indocybium guttatum* (Bloch and Schneider) [= *Scomberomorus g. guttatus* (Bloch and Schneider)] caught off Alleppey, S.W. Coast of India. The anterior part of the cephalothorax, abdomen and anal laminae and the second maxilliped are figured.

Tripathi (1962) records *Pseudocynus (Cybicola) armatus* from the gills of the scombroïd fish *Cybium guttatum* (= *Scomberomorus g. guttatus* (Bloch and Schneider) from Puri, Orissa Coast, India. Two females and a male were obtained by him and the following measurements are given by him for a female and a (male).

Total length 4.393 (1.795); cephalothorax 0.58×0.58 ($p.4 \times 0.4$); thorax and second segment 0.319×0.58 (thorax, second and third segment in male 0.232×0.232); fourth and genital segments

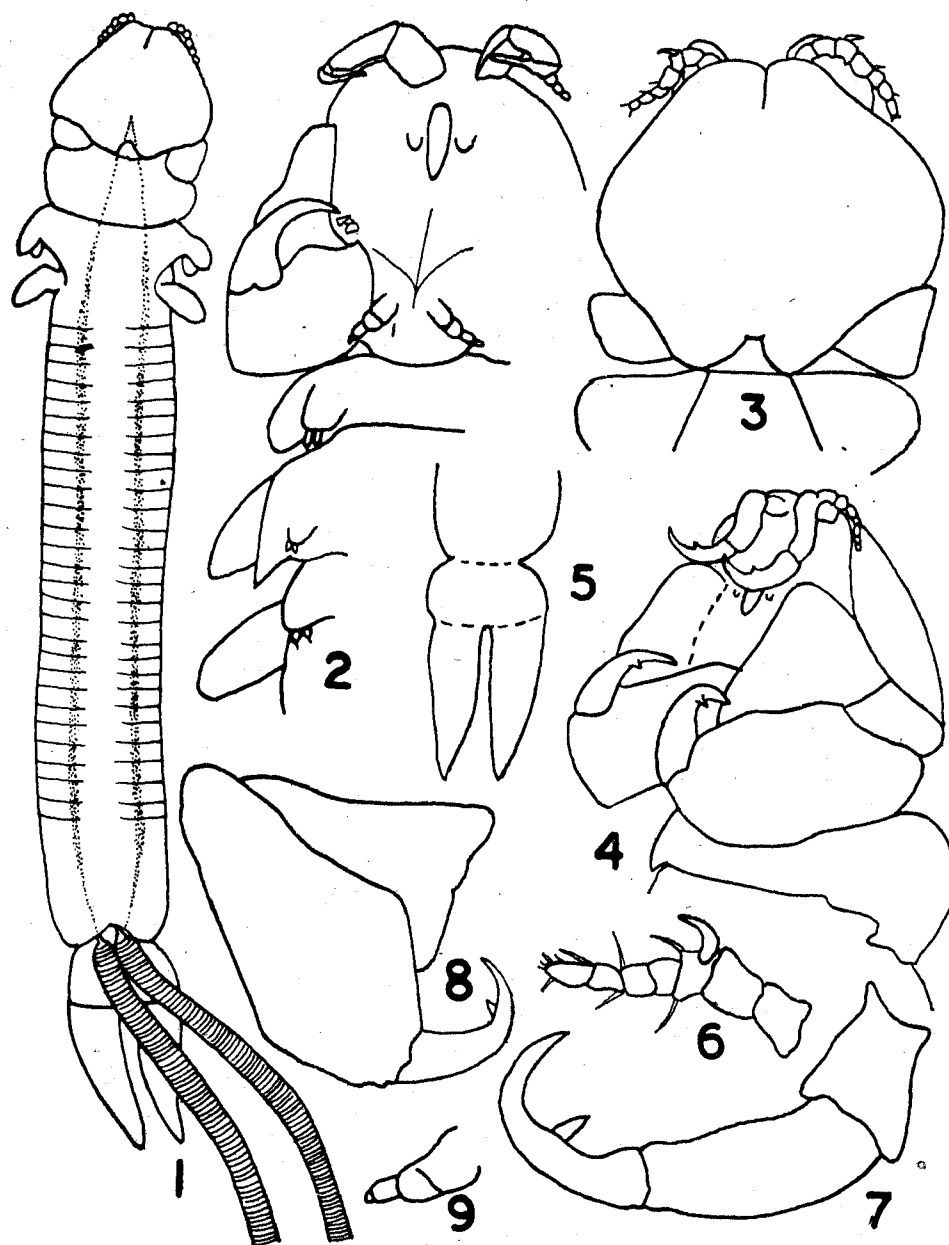


Figure 48. 1-9. *Paracyenus lobosus* Heegaard. Female: 1. dorsal view; 2-4. ventral, dorsal and lateral views of head; 5. posterior ventral region; 6-7. antennule and antenna; 8. maxilliped; 9. first leg (1-9 after Heegaard).

2.465×0.58 (1.029×0.348); abdomen 0.232×0.507 (0.145×0.174); and anal lamina 0.638×0.232 (0.145×0.058 in male).

***Pseudocycnus scomberomori* Yamaguti, 1939c**

(Figure : 49 : 10-18)

Description : Female.—Carapace slightly broader than long, narrowed anteriorly with prominent postero-lateral corners not divided into lobes posteriorly ; first thoracic segment narrower than second ; third and fourth segments with short digitiform processes on either side ; fifth segment indicated by a pair of lateral setae fused with the genital segment ; latter cylindrical, about 3.5 mm. long and 0.55 to 0.65 mm. broad ; abdomen very short, about 0.4 mm. long ; caudal rami

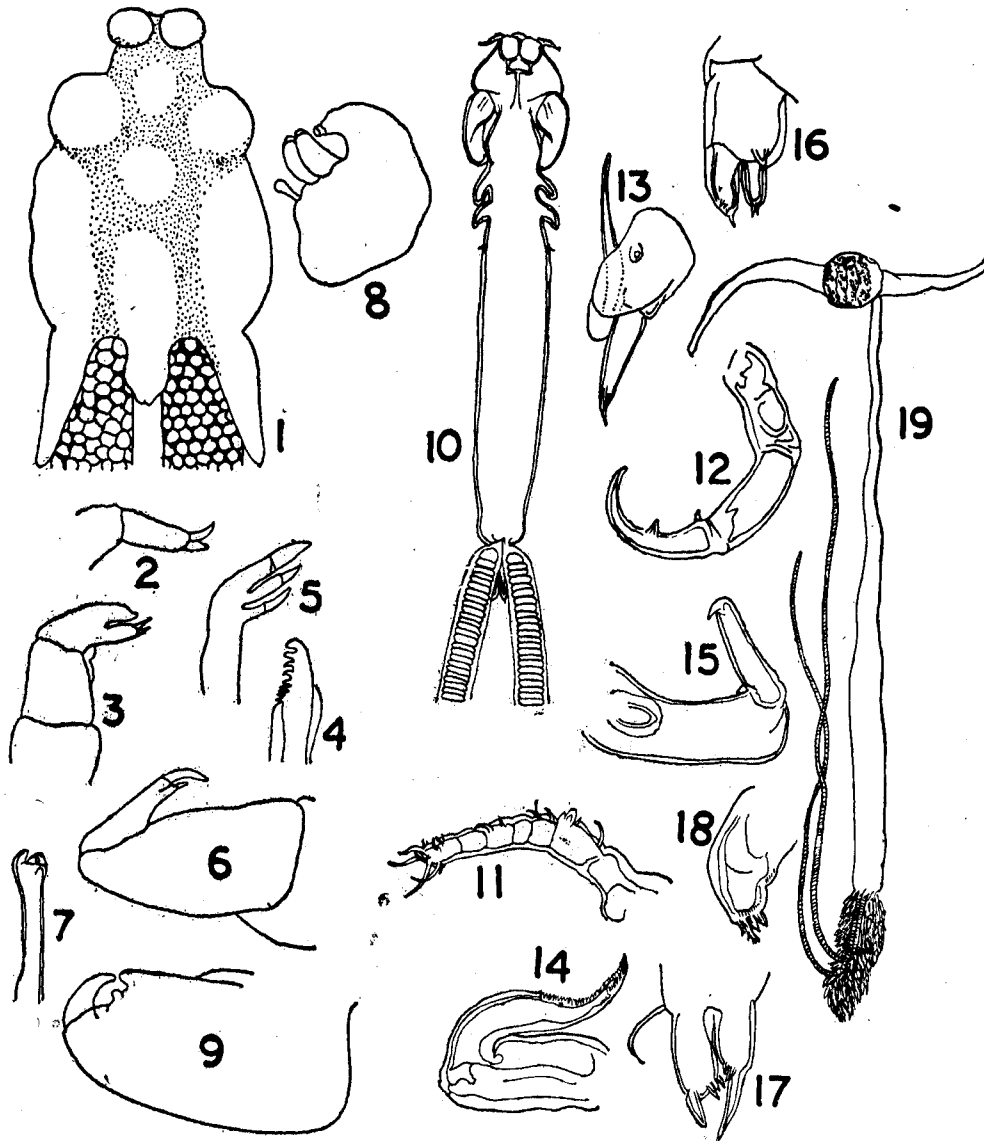


Figure 49. 1-9. *Clavellopsis paradoxa* (van Beneden). Female : 1. dorsal view ; 2. antennule ; 3. antenna ; 4. mandibular apex ; 5. maxillule ; 6. maxilla ; and 7. maxilliped ; Male : 8. lateral view ; 9. maxilla. 10-18. *Pseudocycnus scomberomori* Yamaguti. Female : 10. dorsal view ; 11. antennule ; 12. antenna ; 13. maxillule ; 14. maxilla ; 15. maxilliped ; 16-18. first to third legs. 19. *Pennella instructa* Wilson. (1-9 after Scott & Scott ; 10-19 after Yamaguti).

short, digitiform, about 0.3 mm. long with two setae at about middle of outer margin and a short spine at tip. Egg strings 10.2 to 10.8 mm. long attached to genital segment and dorsal to abdomen. Total length 4.7 to 5.0 mm.

Antennule seven segmented, second segment with a stout blunt spine at distal end of posterior margin ; antenna uncinat, terminal claw with an accessory spine near middle of inner margin and another smaller one at base ; maxillule with two spiniform processes one of which is directed anteriorwards and terminates in two points and the other single and directed inwards ; maxilla with a knob-like protuberance between its base and maxillule ; terminal claw laterally pectinate ; maxilliped when viewed from side consists of stout base with a blunt spine on inner margin and two rami, the inner of which bears two spines and the outer a row of five spines ; second leg biramous, basal segment broad and each ramus tipped with 3 spines ; fourth leg wanting.

Male.—Unknown.

Scombroid host : *Scomberomorus chinensis*.

Locality : Inland Sea, Japan.

Non-scombroid hosts : None.

Location : Gills.

Remarks : Yamaguti (1939c) remarks that the species differs from *P. armatus* (Bassett-Smith) and Kirtisinghe (1935, 1937), primarily in the head being broader than the trunk and the well developed nature of the first leg.

Family : PENNELLIDAE

Genus *Pennella* Oken

Pennella instricta Wilson

(Figure 49 : 19)

Scombroid host : (1) *Istiompax australis* [= *Makaira indica* (Cuvier)]. (2) *Marlina zelandica* (= *Tetrapturus audax* Philippi).

Localities : (1) Broughton Island near Port Stephen, New South Wales, Australia ; (2) Port Jackson, New South Wales, Australia.

Non-scombroid hosts : None.

Location : Heegaard (1962) records seven specimens from the skin of the black marlin and two specimens found embedded in the fin of the striped marlin from Australian waters.

Pennella sp. Ishii, 1916

Ishii (1916) records *Pennella* sp. from the undermentioned scombroid hosts from Japan : (1) *Thunnus orientalis* (Temminck and Schlegel) [= *T. thynnus orientalis* (Temminck and Schlegel)] and *Xiphias gladius* Linnaeus.

Pennella sp. Ho, 1963

Ho (1963) remarks on finding a species of *Pennella* inserted into the bodies of *Xiphias gladius* Linnaeus and *Istiophorus orientalis* (Temminck and Schlegel) (= *I. gladius*) landed at the fishing port of Nanfango in Formosa, but caught off Suao or in the vicinity of the islets of Keelung.

Suborder LERNAEOPODOIDA

Family : LERNAEPODIDAE

Genus *Brachiella* Cuvier, 1817*Brachiella thynni* Cuvier, 1817

Scombroid host : *Indocybium lineolatum* (Cuvier) [= *Scomberomorus lineolatus* (Cuvier)].

Locality : Trivandrum, S.W. Coast of India.

Non-scombroid hosts : See p. 940 in main part of paper.

Location : Posterior side of base of pectoral fin.

Remarks : Pillai (1962c) mentions the above additional scombroid host for this species.

Genus *Clavelloopsis* Wilson*Clavelloopsis paradoxa* (van Beneden), 1851

(Figure 49 : 1-9)

(Syn : *Anchorella paradoxa* van Beneden, 1851 ; *Clavella paradoxa* Scott and Scott, 1913).

Description : *Female*.—Cephalothorax fairly elongate; deflected backwards upon genital segment and slightly longer than that; genital segment subquadriform with posterior corners produced postero-laterally and tapering; an unpaired knobular process situated dorso-medially between lateral processes of genital segment; anterior part of genital segment with three shallow knob-like projections; two similar, but smaller knobular projections on anteriormost part of head; antennule two-segmented and antenna three-jointed; distal end of mandible serrated on one side; maxilla slender with three digitate terminal processes; first maxilliped two segmented with terminal claws; second maxilliped short, coalascent and fixed to terminal chitinous plug; size exclusive of cephalothorax about 4 mm.

Male.—Minute, nearly globular in shape; second maxilliped relatively stouter than in female with single terminal claw.

Scombroid host : *Scomber scombrus* Linnaeus.

Localities : British and Irish Seas.

Non-scombroid hosts : None.

Location : Gill filaments of host.

References : van Beneden (1851), Bassett-Smith (1896), Scott (1906), Scott and Scott (1913), Wilson (1915), and Yamaguti (1939a).

Remarks : This species does not fully conform to the generic diagnosis given by Wilson (1915, 1932). The presence of the posterior processes of the genital segment distinguishes it from *Clavella* and *Clavellisa*.

Clavelloopsis saba Yamaguti, 1939a

(Figure 50 : 1-10)

Description : *Female*.—Trunk elliptical about 2.8 to 3.7 mm. long, 1.0 to 1.8 mm. broad with a pair of conical processes; median genital process fairly large, rounded, and of same length as lateral processes; cephalothorax in line with maxillipeds, slender, 4.3 to 5.0 mm. long and 0.34 to 0.6 mm. thick; head not enlarged, bluntly rounded in front; antennule three segmented, basal segment with a knobular enlargement on antero-medial side and terminal segment tipped with 4 spines; antenna biramous, anterior ramus one segmented, bluntly rounded and finely

spined; posterior ramus two segmented, as long as anterior one, with two short spines and nodule at tip which is spined; mandible with a row of 10 teeth, distal one rather blunt and proximal pointed; maxillule terminating in three spiniform processes one of which is small; proximal segment of maxilla stout with a single median spine on inner side surrounded by spinules; distal segment with a spine on ventral side denticulated and a terminal claw; maxilliped fused throughout its length, and abruptly narrows near the tip where it forms a collar-like fold; a pair of large protuberances present on ventral side of maxillipeds.

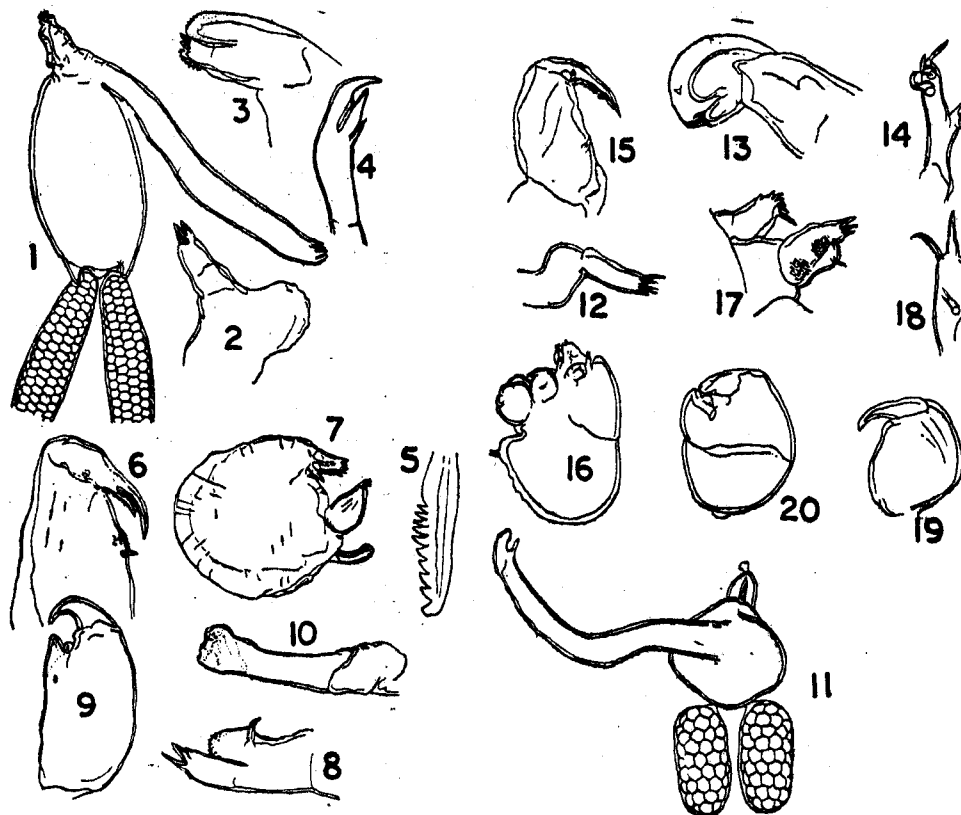


FIG. 50. 1-10. *Clavellopsis saba* Yamaguti. Female: 1. cephalothorax lateral view and trunk ventral view; 2. antennule; 3. antenna; 4. maxillule; 5. mandible; 6. maxilla; Male: 7. lateral view; 8. antenna; 9. maxilla; 10. maxilliped. 11-20. *Clavellisa scombri* (Kurz). Female: 11. adult; 12. antennule; 13. antenna; 14. maxillule; 15. maxilla; Male: 16. lateral view; 17. antennule and antenna; 18. maxillule; 19. maxilla; 20. maxilliped (1-20 after Yamaguti).

Male.—Body 0.56 mm. long; cephalothorax 0.34 mm. long; trunk strongly arched dorsally; antennule similar to female; anterior ramus of antenna much shorter than posterior one and provided on outer side of its base with a relatively large spine; maxilla with a stout basal segment and a single terminal claw extending against conical process of basal segment; basal segment of maxilliped rod-like and attenuated at distal end with a depression covered with minute blunt spines at distal corner against which the small terminal claw shuts down.

Scombroid host: *Scomber japonicus* (= *Scomber j. japonicus* Houttuyn).

Locality: Sizuoka Prefecture, Japan; Tsunodayama, Niigata Prefecture, Japan.

Non-scombroid hosts: None.

Location: Gills.

Reference: Yamaguti (1939a).

HOST—PARASITE LIST

(The generic names of host and parasite species are alphabetically arranged in the list. As the original description of *Tuxophorus cybii* Nunes-Ruvio (1956) has not been consulted in original, the name of the host species is not available for inclusion in this list).

Host species	Parasite species
<i>Acanthocybium solandri</i> (Cuvier).....	<i>Tuxophorus solandri</i> Kurian
<i>Auxis thazard</i> (Lacépède).....	<i>Caligus auxisi</i> Pillai
<i>Euthynnus affinis affinis</i> (Cantor)	<i>Caligus affinis</i> Kurian <i>Caligus amblygenitalis</i> Pillai <i>Caligus coryphaenae</i> Steenstrup and Lutken <i>Caligus euthynnus</i> Kurian <i>Caligus kuroshio</i> Shiino <i>Caligus thynni</i> Pillai
<i>Euthynnus affinis yaito</i> Kishinouye.....	<i>Caligulus longispinosus</i> Heegaard <i>Caligus alveolaris</i> Heegaard
<i>Istiophorus gladius</i> (Broussonnet)	<i>Gloiopotes watsoni</i> Kirtisinghe <i>Pennella</i> sp. Ho, 1963
<i>Katsuwonus pelamis</i> (Linnaeus)	<i>Caligus coryphaenae</i> Steenstrup and Lutken
<i>Makaira indica</i> (Cuvier).....	<i>Gloiopotes longicaudatus</i> (Marukawa) <i>Pennella instricta</i> Wilson
<i>Rastrelliger kanagurta</i> (Cuvier)	<i>Bomolochus aculeatus</i> Pillai <i>Caligus kanagurta</i> Pillai <i>Lernanthropus kanagurta</i> Tripathi
<i>Scomber japonicus japonicus</i> Houttuyn.....	<i>Clavellopsiis saba</i> Yamaguti
<i>Scomber scombrus</i> Linnaeus	<i>Clavellopsiis paradoxa</i> (van Beneden)
<i>Scomberomorus chinensis</i>	<i>Pseudocycnus scomberomori</i> Yamaguti
<i>Scomberomorus commerson</i> Lacépède	<i>Caligus obovatus</i> Heegaard <i>Caligus maculatus</i> Heegaard <i>Caligus proboscoidactus</i> Heegaard <i>Caligus quinqueabdominalis</i> Heegaard <i>Paracycnus lobosus</i> Heegaard <i>Tuxophorus cervicornis</i> Heegaard
<i>Scomberomorus guttatus guttatus</i> (Bloch and Schneider)	<i>Caligus brevisoris</i> Shen <i>Pseudocycnus armatus</i> (Bassett-Smith)
<i>Scomberomorus niphonius</i> (Cuvier).....	<i>Caligus microdontus</i> Heegaard
<i>Scomberomorus lineolatus</i> (Cuvier).....	<i>Brachiella thynni</i> Cuvier

<i>Scomberomorus queenslandicus</i> Munro	<i>Caligus maculatus</i> Heegaard <i>Caligus obovatus</i> Heegaard <i>Caligus proboscoidatus</i> Heegaard <i>Paracycnus lobosus</i> Heegaard
<i>Tetrapturus audax</i> Philippi	<i>Gloiopotes longicaudatus</i> (Marukawa) <i>Pandarus satyrus</i> Dana <i>Pennella instricta</i> Wilson
<i>Thunnus thynnus orientalis</i> (Temminck and Schlegel)	<i>Pennella</i> sp. Ishii, 1916
<i>Xiphias gladius</i> Linnaeus	<i>Pennella</i> sp. Ishii, 1916

REFERENCES

(Only those references not listed in the main part of the paper are listed here).

- HEEGAARD, P. 1962. Parasitic Copepoda from Australian waters. *Rec. Aust. Mus.*, 25(9) : 149-234, with figs. 1-250.
- . 1964. New names for *Caligus dentatus* and *Hatschekia elongata*. *Crustaceana*, 6(4) : 319-320.
- HO, JU-SHEY, 1963. On five species of Formosan parasitic copepods belonging to the suborder Caligoida. *Crustaceana*, 5(2) : 81-98.
- KURIAN, C. V. 1955. Parasitic copepods of Travancore-Cochin. *Bull. Central Res. Inst. Trivandrum*, 4(1) : 103-116.
- . 1961. Parasitic copepods of fishes from Kerala. No. 3. *Bull. Res. Inst. Univ. Kerala, Ser. C., Nat. Sci.*, 8 : 63-77.
- NUNES-RUIVO, L. 1956. Copepodes Parasitas de peixes dos mares de Angola. *Trabalhos da Missao de Biologia Maritima, Lisboa*.
- PILLAI, N. KRISHNA. 1962a. On a new species of *Bomolochus* (Copepoda) with remarks on *Orbitacolax* Shen. *J. Parasitol.*, 48(4) : 610-612.
- . 1962b. On *Caligus coryphaenae* Steenstrup and Lutken, 1861. *Ann. Mag. Nat. Hist.*
- . 1962c. Copepods parasitic on South Indian Fishes. Families Lernaepodidae and Naobranchidae. *J. Mar. biol. Ass. India*, 4(1) : 58-94.
- . 1963. Copepods parasitic on South Indian Fishes. Family Caligidae. *Ibid.*, 5(1) : 68-96.
- TRIPATHI, Y. R. 1962. Parasitic copepods from Indian Fishes. III. Family Anthosomatidae and Dicheles-thidae. *Proc. First All-India Zool. Congr.*, Pt. 2 : 191-217.